DEPARTMENT OF THE AIR FORCE

AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/GIS/LAS/98S-2

AN ANALYSIS OF INFORMATION TECHNOLOGY TRAINING EFFECTIVENESS: THE IMPACT ON TRAINEE REACTIONS, LEARNING, AND PERFORMANCE

THESIS

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THESIS

Presented to the Faculty of the Graduate School of Logistics

and Acquisition Management of the Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Information Systems Management

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September 1998

Approved for public release; distribution unlimited

Acknowledgements

I am extremely grateful to have had the opportunity to complete an AFIT degree and with it, this thesis. There is no doubt I have developed additional skills and analytical abilities that will serve me well throughout my career and my life. I extend my deep appreciation and admiration to the faculty and staff of the Air Force Institute of Technology, School of Logistics and Acquisition Management for helping me attain my goals and for their dedication and enthusiasm in teaching and research. In particular, our program manager, Dr. Alan Heminger, promoted the open exchange of ideas in an encouraging atmosphere and continually amazed me with his support for my sometimes headlong charge into the AFIT curriculum. Their combined brilliance and expertise was a continual source of inspiration to me throughout this process.

Key to my efforts was the outstanding relationship I had with my thesis advisor, Major Mike Morris. Not only did he provide me with guidance, direction, and motivation, but also he also shared with me his friendship and a decent golf game. In addition, the ever-reliable and precociously unique advice of my readers, Dr. Robert Steel and Lieutenant Colonel Steve Atkins, added valuable insight and greatly improved the quality of my thesis. Their areas of expertise opened up new vistas and helped me develop new approaches to the management problem. I thank all of them for their encouragement. They helped me become a better officer and person.

Finally, I'd like to reserve a special thanks and love for my parents, Henry and Judy Scherrer. They have always quietly supported me in whatever I did, and during my time here at AFIT this support became a primary source of strength. My only wish was to make them proud of their son.

Joseph H. Scherrer

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Abstract

Through its "Global Reach", the Air Force operates globally and in environments that are potentially dynamic, competitive, and lethal. "Information Dominance" has assumed a central role in such environments. In order to achieve Information Dominance, the Air Force must have trained and skilled personnel able to perform highly intensive activities using information technologies. Therefore, it is crucial that information technology training be able to deliver the requisite skills personnel need to attain and sustain performance on these systems.

The importance of training gives rise to the need to determine how information technology training can be continually improved to maximize return on training dollars and produce adequately trained personnel. Evaluation of information technology training provides such an avenue by providing information that assesses how well the training program is meeting its goals, both during training and on-the-job.

This thesis analyzes the impact of information technology training on trainee reactions, learning, and performance via an information technology training program for a global Air Force command and control (C2) system. Trainee confidence, perceptions, attitudes, test scores, and performance with regard to the C2 system are analyzed to discover if the training positively increases any of these factors. Among the most important results presented is the degree of trainee on-the-job performance improvement using the system following training.

With training's relationship to these factors clearly outlined and understood, information technology training courses can be improved and resources allocated to those courses that consistently produce skilled personnel who can perform using information technology.

AN ANALYSIS OF INFORMATION TECHNOLOGY TRAINING EFFECTIVENESS: THE IMPACT ON TRAINEE REACTIONS, LEARNING, AND PERFORMANCE

I. Introduction

Chapter Overview

This chapter discusses how the pervasiveness, growth, and importance of information systems in the workplace mandate the need for personnel training on these systems. A theoretical argument supporting the need for training is developed by linking the issues of information technology investment, training effectiveness, and trainee performance to information systems training. Next, operational definitions of training, reaction, learning, and performance are listed along with a model depicting their theorized interactions. Then, investigative questions are identified that define the scope of this research. Finally, the contributions of this thesis to the Air Force and an outline of subsequent chapters are presented.

Background

Increasing globalization of the world's economy demands that firms also operate globally. Information and information systems provide the analytic and communications power firms need for conducting trade and managing business on a global scale (Laudon and Laudon, 199:3). Because of global information and communications, customers can now operate in a 24-hour market. Firms who exploit this phenomenon gain a significant

competitive advantage while those who do not find themselves consistently outmaneuvered (Hammer and Champy, 1993:100). Robust information and communications are now the "price of entry" into the global market. This is not only true in the commercial sector. The Air Force operates globally and in environments potentially more dynamic, competitive, and lethal than those of business. In fact, the same information and communications capabilities that the business world requires are required by the Air Force at an equal or even higher level.

Information technology (IT) plays an important role in organizations. According to the July, 1997, edition of Datamation, the combined annual IT revenue in 1996 for the world's top 100 IT vendors was $502 billion. This figure does not include the human resources invested in developing and running information technology systems in all the firms that use IT (as opposed to inventing, making, and selling it). Thus, it seems reasonable to conclude that 1997 worldwide expenditure on IT-related activities likely exceeds $1 trillion per annum .

The tremendous deployment of computerized technologies over the past decade has changed the face of the workplace. Sophisticated computerized technologies are now common in factories, offices, and on the battlefield. Based on census numbers between the years 1984-1989, the number of workers using a computer at work increased from 24.6% to 37.4%: a 50% increase (Krueger, 1993). Over 35% of firms reported they had personal computers in 1989, compared with fewer than 10% in 1984. Experts predict that by the year 2010, new information technologies will affect the jobs of approximately 90% of the workforce (Hines, 1994). In fact, a 1997 study by the United States Department of Commerce Office of Technology Policy warned of a growing IT staffing

shortage as information technology becomes more important to companies. The report estimates that the United States will require more than 1 million IT workers by 2005, and if the IT worker shortage is not resolved soon, the report suggests the U.S. economy may suffer a significant decline in productivity across all business sectors. With the majority of personnel using some form of IT in their jobs, IT training becomes a vital issue.

The facts show that a large and growing proportion of the world's economic resources and human resources are now devoted to the development, production, and use of information technologies (Laudon and Laudon, 1997:4). Organizations invest in information technology because they want to increase productivity, gain a competitive advantage, reengineer processes to become more responsive to customer needs, or provide better information for decision-making. With so many billions of dollars being invested in IT each year and the human resources required, it is important that organizations understand how to apply the technology effectively. One way to be effective is to train personnel to use IT.

Training is defined as a planned effort by an organization to facilitate the learning of job-related behavior on the part of its personnel in order to meet organizational goals (Wexley and Latham, 1991:3). Training plays a crucial role in the successful implementation of computerized technologies in the workplace and in improving competitiveness. Ample research and practical experience show that training is an effective means of increasing organizational productivity (Burke and Day, 1986; Guzzo, Jette, and Katzell, 1985; Russell, Terborg, and Powers, 1985). A qualitative study by Klein and Ralls (1995) found that training was mentioned as an essential success factor for technology implementation in 67% of 18 case studies. McKersie and Walton (1991)

reported that, in six case studies of technology implementation, interviewees emphasized the importance of training in facilitating organization change and successfully introducing new technology. If spending on training is any measure, firms and government organizations seem to agree that training is important. Commercial firms spend $30 billion on formal training and another $180 billion on on-the-job training (Tannenbaum and Yukl, 1992).

The Air Force is no different. According to the President's budget for FY 1999, the Air Force training budget is projected to be $1.7 billion. The trend toward training in general and IT training in particular is not projected to abate any time soon. In fact, the top ten human resource development (HRD) trends all center around training and computer training in particular, according to the Association for Training and Development's July 1997 National HRD Executive Survey. These trends, in order of importance, are listed below.

<u>Top 10 HRD Trends</u>

1. Computer skills training
2. Teamwork training
3. Shift from training to performance
4. Decision-making and problem-solving training
5. Rapid development and deployment of training
6. Systems-thinking training
7. Demonstrating training outcomes
8. Measuring performance outcomes
9. Shift from training to learning
10. Making a business case for training interventions

These trends amplify the fact that an organization that wishes to continually leverage its IT investment must ensure that it has competent personnel to operate and maintain the system. This link between information systems and training is established

during the initial deployment of the system and is sustained until the end of its life cycle. It makes sense, then, to view IT training as a part of a process-oriented system that uses continual evaluation of its IT training programs to measure program effectiveness. The information gained from evaluation can help determine where new training techniques can be incorporated to improve training effectiveness and maximize return on training dollars (Goldstein, 1974:24).

The necessary evaluative information must be obtained and used to modify and improve IT training programs. If a training program accomplishes its stated objectives, then it can be considered effective (Quinones, 1997:179). Systematic training evaluation helps eliminate subjective judgments of training effectiveness that often lead to difficulty in justifying training costs and to training budget cuts during fiscal downturns (Zenger and Hargis, 1982: 11). Worse, the organization may lose the competitive advantage gained from the use of its information system as well as its investment. Brinkehoff (1991) suggests that training programs be evaluated in order to provide convincing data for training effectiveness and determine their contribution to an organization's goals. Specifically, he suggests that training programs should:

- be aimed at important and worthwhile organizational benefits
- use the best available and most cost-effective designs and plans
- operate smoothly and efficiently and are enjoyed by participants
- achieve important skill, knowledge, and attitude objectives
- be used effectively on the job
- produce valuable and cost-effective organizational benefits

In military terms, training should be a "force multiplier" that improves mission effectiveness with fewer resources (Salas, Cannon-Bowers, Kozlowski, 1997:365).

Despite the value of evaluating training, determining IT training effectiveness is not easy. Many individual and situational factors influence IT training effectiveness such as demographics, abilities, attitudes, tools and equipment, financial and budgetary support, climate, and culture, among others (Mathieu and Martineau, 1997:199-214). Fundamentally, however, managers must determine if individual IT training transfers to the workplace and whether it has impact on the organization (Compeau and Higgins, 1995:24).

A good evaluation process centers around two procedures: establishing measures of training success (criterion measures) and using experimental and nonexperimental designs to determine if desired changes have taken place as a result of training (Goldstein, 1974:24). At a minimum, criteria must be established for both the evaluation of trainees at the conclusion of the training program and the evaluation of on-the-job performance.

Research Context

Air Mobility Command (AMC) has implemented and maintains a robust training development and evaluation program centered on command and control and information system administrator personnel required to utilitize its Command and Control Information Processing System (C2IPS). AMC uses an instructional system development (ISD) process to plan, design, develop, and implement training programs in an effective and cost-efficient manner. As originally adopted in the Air Force, the goal of instructional systems development was to increase the effectiveness

and efficiency of education and training by fitting instruction to jobs, eliminating irrelevant knowledge while ensuring that trainees acquire the necessary skills, knowledge, and attitudes to do the job (AFMAN 36-2234, 1993:7). ISD requires that training design meets specific job requirements that have been identified through training needs assessments, that training is designed for all job tasks and knowledge necessary for successful performance on the job, and that training is designed to meet specific training objectives (AMC/DOOC, 1997:7). Instruction is then provided in the areas most critical to job performance and is not wasted on areas having a low probability of meeting immediate or critical long-term needs.

The training evaluation framework chosen to evaluate the C2IPS training program was first developed by D.L. Kirkpatrick in 1959. Today, the Kirkpatrick framework is used by 67% of organizations that conduct evaluations. It provides the study's measurement framework (ASTD, 1997:3). The framework includes criteria for assessing trainee reactions to training, learning, and performance. In addition, the information technology based nature of the C2IPS training program is addressed through the use of four criteria from the management information system (MIS) literature.

Kirkpatrick training criteria include reaction, learning, behavior, and results. Reaction criteria measure trainees' affective response to the quality or relevancy of training (Kraiger and Jung, 1997:152). Reaction responses constitute the opinions or "feelings" of the participants and are usually captured through questionnaires. This study uses four types of MIS reaction criteria previously studied in the literature: computer self-efficacy (Compeau and Higgins, 1995), computer attitude (Igbaria and Parasuraman, 1991), perceived usefulness (Davis, 1989), and perceived ease of use (Davis, 1989).

Computer self-efficacy measures trainee confidence in the ability to accomplish relevant computer-related job tasks. Computer attitude measures trainee attitudes toward using computers in accomplishing relevant computer-related job tasks (Igbaria and Parasuraman, 1991:555). Perceived usefulness measures how much a trainee thinks a given computer system will improve his/her job performance (Davis, 1989:985). Perceived ease of use measures the degree to which a trainee expects a given computer system to be free of effort (Davis, 1989:985). Learning criteria measure the learning of principles, facts, and techniques specified in training program objectives (Kraiger and Jung, 1997:152). Learning measures must be "objective and quantifiable indicants of the learning that has taken place in the training program" (Goldstein, 1974:60). Learning measures are obtained through academic tests administered as part of the C2IPS training courses. Behavior or performance criteria capture on-the-job behavior resulting from the training program (Kraiger and Jung, 1997:152). They are measured using tailored questionnaires given to the trainee and the trainee's supervisor. Figure 1 depicts the modified Kirkpatrick model used for this study.

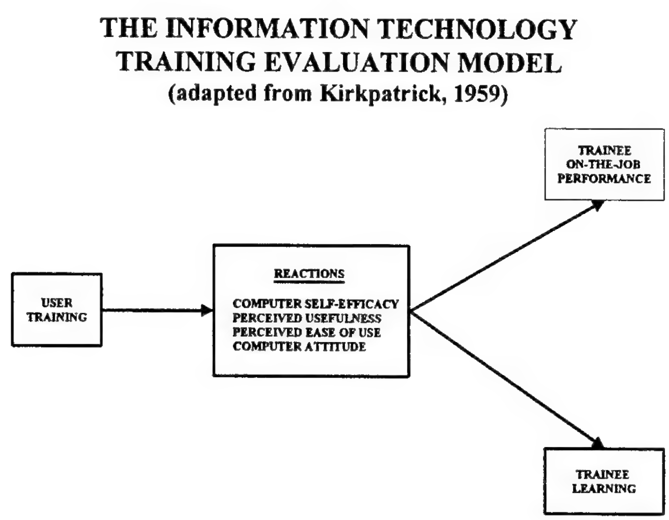


Figure 1. The Information Technology Training Evaluation Model

Research Problem

This study uses Air Mobility Command's Command and Control Information Processing System (C2IPS) training program as a platform to investigate the impact of individual C2IPS training. C2IPS is an AMC information system that tracks airlift, coordinates tankers, and interfaces with other command and control systems. The competitive advantage of C2IPS lies in its ability to provide real-time visibility and control of airlift missions for units below the MAJCOM level. For C2IPS to achieve its purpose of tracking and controlling airlift, personnel must be effectively trained on the system. As a tool in evaluating training success, program managers responsible for AMC C2IPS training expressed a desire for evaluative data on the impact of C2IPS training on on-the-job C2IPS performance.

Investigative Questions

The following research questions form the basis of this thesis.

- What is the relationship between trainee reactions, learning, and performance?
- Does information technology training increase trainee reactions and learning?
- Does information technology training increase performance on the information systems after training?

Answering these questions will shed light on the impact information technology training has on trainee reactions, learning, and performance and allow trainers and supervisors to better assess the impact of this training on the organization.

Thesis Contribution

This thesis contributes to the understanding of information technology training and how it impacts performance. For Air Mobility Command (AMC), continuous and successful performance of C2IPS tasks are vital to providing command and control of cargo and tanker aircraft in support of "Global Reach" for the Air Force. The results of this thesis can enable AMC and Air Education and Training Command (AETC) leadership to assess and improve key components of their C2IPS training program related to C2IPS operator and system administrator job performance as well as efficiently allocate resources to the C2IPS training. Further, the Air Force Research Laboratory (AFRL) can integrate the results of this study into development of future command and control and logistics information systems training programs. By understanding the components of performance and how information systems contribute to performance, AFRL can research and develop more effective information systems. At an individual level, training instructors and supervisors can use the results of this study to evaluate the benefits of the C2IPS program to improve course content, evaluate training progress, and assess performance improvement. In addition, the research methodology used in this study can be used to institutionalize information technology training evaluation into all AMC, AETC, and AFRL training programs. Finally, this research can make a contribution to the overall academic information systems and training literature by increasing understanding of the relationships between training, information technology, and job performance.

Thesis Outline

Chapter II of this paper will present a review of applicable literature from academic sources. Chapter III will provide the methodology to answer the propositions outlined in Chapter I. Chapter IV presents a statistical analysis of the data collected from the study. Finally, a discussion of the results and subsequent conclusions will be included in Chapter V.

II. Literature Review

Chapter Overview

The deep penetration of information technology into the planning and operation activities of an organization requires new considerations for managing the use of IT throughout the organization (Lee, Kim, and Lee, 1995:190). Although much research has been conducted on the consequences of computerization on performance, productivity, and employee satisfaction, empirical literature paints an inconsistent picture of how much impact computerization has on these factors (Klein and Ralls, 1997:324). However, some evidence suggests that IT can have a significant positive impact on an organization, especially on job task performance, if the firm provides adequate education and training for all levels of end users (Nelson and Cheney, 1987:547-559). Classic models of organizational training support this view of training, but some have said that training "has generally been slow to integrate theoretical concepts from other research areas" and is "too micro in its orientation" (Kozlowski and Salas, 1997:247-248). This chapter suggests an approach to alleviate these concerns by integrating traditional training concepts with those derived from management information systems (MIS) research and training research in the hope of presenting a better way of evaluating the relationship of IT training to job task performance.

This chapter examines several areas of interest. First, the evolution of training as an organizational discipline sets a historical background for the training context. Next, integrated system design (ISD) of training programs is addressed with special emphasis on Air Force application of ISD and the notion of training evaluation within ISD. Then,

the Kirkpatrick framework for training evaluation is outlined including discussion of the model's four criteria: reaction, learning, behavior, and results and their relevance to evaluation.

Following the discussion of the training perspective, the MIS training perspective is addressed. IT constructs involving IT acceptance, attitude, and self-efficacy are described in relation to IT training. In addition, the MIS constructs are linked to similar organizational behavior constructs to support hypothesized independent variable/dependent variable relationships.

Finally, approaches to training research are addressed including issues of design, reliability, validity, and survey research. Because performance ratings are crucial to the outcome of this study, particular attention is paid to the nuances of self-report and supervisor performance rating.

Training and Training Evaluation

Background. In the first review of modern industrial training, McGehee (1949) noted that the dictionary definition of training was relatively narrow and was related solely to processes associated with gaining proficiency in a specific skill or competence (Ford, 1997:2). He also noted that the amount and nature of research was small and anecdotal (Ford, 1997:2). In contrast to this narrow definition of training, McGehee saw the setting of industrial training as

> much broader in scope with training programs designed to induct the new worker, improve the performance of experienced workers and managers, and to inform the worker concerning basic economics and to counteract collectivistic ideology. (Ford, 1997:4)

Interestingly, McGehee cited the large amount of military research on training as potentially valuable to industrial training including applying psychological principles to training, evaluating training, standardizing training through job analysis and development of lesson plans, and designing equipment for the operator (Ford, 1997:4). McGehee asserted that there was a need for more systematic approaches to training and provided a list of training problems that required the development of new techniques and methods. These problems included who to train, what the content of training should be, what methods are to be used in training, who is to do the training, and how the outcomes of training activities are to be evaluated (McGehee, 1949). With regard to evaluation, McGehee (1949) maintained that the main reasons for a paucity of training evaluations were a lack of statistical research and skill among training personnel and a lack of support among top management for controlled training studies (Ford, 1997: 5).

A second review of the training literature conducted by Campbell (1971) revealed that many of the issues addressed by McGehee were close to fruition. Of particular note was the contributions of military training and instructional psychology literatures on the development of the Instructional Systems Design Model for linking training needs assessment to training objectives, design, and evaluation (Ford, 1997:6). However, problems still remained including lack of focus on learning objectives, the lack of theoretical models and empirical studies, and the lack of factors impacting training effectiveness (Ford, 1997:7).

The most recent review completed by Tannenbaum and Yukl (1992) concentrated on training needs assessment, design, selected training methods, trainee characteristics, pretraining and posttraining environments, and evaluation. Tannenbaum and Yukl

demonstrated that many of the problems Campbell identified had been addressed including a research base that described the multiple factors that can impact training effectiveness including trainee characteristics, training design principles, and work context (Ford, 1997:7). In addition, their summation of training research showed that training cannot be perceived as an isolated event, but rather, as part of the ongoing dynamic and changeable processes in work organizations (Ford, 1997:7). The military, because of its need to train large number of recruits and personnel for a variety of jobs, was perhaps the first to recognize the need for an integrated systems view of training (Goldstien, 1993). It was one of the first organizations to adopt the Instructional Systems Design Model (ISD).

Instructional Systems Design Model. The instructional systems design model is a rational approach in which the design of training programs is based on needs assessment and the psychological research on learning and transfer (Dipboye, 1997:31). The model fuses aspects of training from the fields of industrial and personnel psychology and is an application of the philosophy of human resource management (HRM). HRM assumes that organizational effectiveness can be improved through people-oriented activities such as staffing, training, and wage and salary administration (Bolman and Deal, 1991). The HRM function is managed in a way to maximize the economic utility of the HRM programs, such as training (Murray and Dimick, 1978). For HRM programs, organizational goals serve as the standards against which the programs are evaluated (Beer and Spector, 1984), and the job is used as the building block of the organization (Ash, Levine, and Sistrunk, 1983). Therefore, the primary strategy for improving

organizational effectiveness is to provide a good fit between the person's knowledge, skills, and abilities and the requirements of the job.

ISD implements the rational HRM approach (Dipboye, 1997:32). According to this model, effective training is based on a careful needs assessment, is implemented through "precisely controlled learning objectives design to achieve instructional objectives" (Goldstein, 1991:514), and is evaluated against performance criteria. The usual process is to start with a formal job analysis to determine the knowledge, skills, and abilities required of personnel and the criteria for measuring their performance. This is followed by an evaluation. The widespread acceptance of the Air Force ISD model, as a rigorous approach for managing the training process is shown in the frequent use of this model in both the evaluation literature and in instructional practice (Goldstein, 1993; Latham, 1988; Wexley, 1984; AFMAN 36-2234). In fact, the Air Force uses the ISD model as the foundation for its training programs (AFMAN 36-2234, 1993:5). Figure 3 below shows the Air Force ISD model.

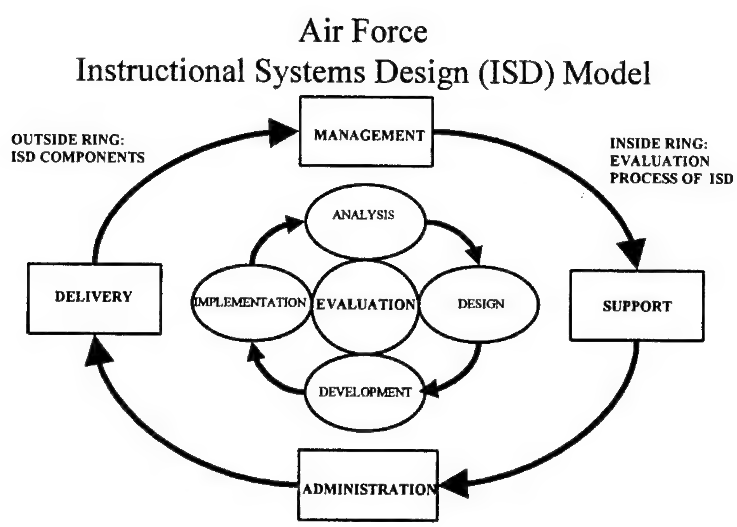


Figure 2. Air Force Instructional Systems Design Model (AFMAN 36-2234, 1993:5)

The Air Force ISD process, first implemented in 1965, provides a systems approach to planning, developing, implementing, and managing education and training programs. The goal of Air Force ISD is to increase the effectiveness and cost-efficiency of education by:

- Developing instruction based on job performance requirements.
- Eliminating irrelevant skills and knowledge instructions for courses.
- Ensuring graduates acquire the skills, knowledge, and attitudes to do the job.

The product of the ISD process is a total quality instructions system that is cost-effective and produces graduates who can do the job (AFI 36-2201:7). In the ISD model the last step in the training cycle is crucial and consists of a rigorous evaluation of the training criteria identified in the needs assessment phase (Dipboye, 1997:34). An evaluation should allow an identification of which criteria have changed, whether these changes are the result of the training program, and whether the same changes will occur in future replications of the program with different participants (Dipboye, 1997:34).

Evaluation. In the Air Force ISD model, evaluation is a continuous activity that is integrated throughout each stage of ISD, beginning with analysis and continuing throughout the life cycle of the system (see Figure 3). For the purpose of this study, however, operational evaluation is the main concern. Operational evaluation is the continuous process of gathering and analyzing internal and external feedback data to ensure that the system continues to effectively and cost-effectively produce graduates who meet established requirements (AFMAN 36-2234, 1993:77). An operational evaluation looks for strengths and weaknesses in on-going training and determines the following:

- How well the graduates are meeting job performance requirements.
- Whether instruction is being provided that is not needed.
- Whether any needed instruction is not being provided.
- How well each system component is contributing to overall system quality.
- Ways to improve the graduate's performance as well as the training program.

The two operational evaluation activities are internal and external evaluation. Internal evaluation gathers and analyzes internal feedback and management data from within the training environment to assess the effectiveness and quality of the instructional process. External evaluation gathers and analyzes external feedback data from the field to assess graduates' on-the-job performance in an operational environment. In the Air Force ISD model, evaluation is key to continual success in achieving training program goals. For this study focus is on graduate performance.

The Kirkpatrick Framework. Like ISD, the Kirkpatrick training evaluation framework is an outgrowth of behavioral psychology and general systems theory. Although the framework is not specifically identified in Air Force publications addressing evaluation, Kirkpatrick's evaluation criteria are readily applicable to the Air Force ISD model (AFMAN 36-2234:99-100). From this standpoint, the Kirkpatrick framework is particularly well suited to evaluation of Air Force training programs. Figure 4 shows the framework.

Reaction, aside from being the most popular measure of training (Alliger, Tannenbaum, Traver, Bennett, Shotland, 1997:341), is often a critical factor for the continuance of training programs (Phillips, 1991:44). Reaction measures how

The Kirkpatrick Training Evaluation Framework (1959)

(from Alliger et. al., Personnel Psychology, 1997)

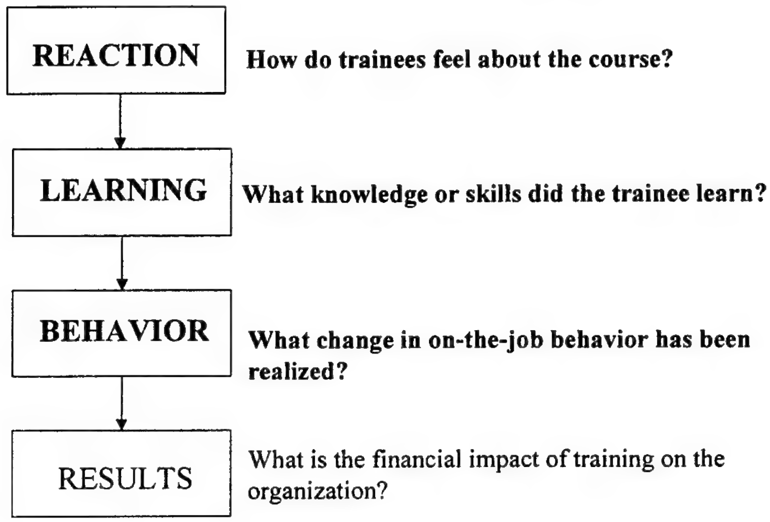


Figure 3. The Kirkpatrick Training Evaluation Model (1959)

participants feel about a program and what a person thought of the training program (Kirkpatrick, 1977:9). Most trainers believe that initial receptivity provides a good atmosphere for absorbing the material in the training program but that it does not necessarily produce high levels of learning or performance (Goldstein, 1974:60).

Kirkpatrick's next evaluation criterion, learning, is typically indexed by results of traditional tests of declarative knowledge (Alliger, et al., 1997:345) and is intended to provide an indication of how well trainees have mastered the knowledge and skills taught to them during a training course (Kraiger and Jung, 1997:152). Learning may be defined as the knowledge and skills a trainee has acquired as a result of training (Kirkpatrick, 1977:9). Test content is compiled from the content of the training course, and multiple test items are constructed and administered to trainees at the end of or throughout the course (Bretz and Thompsett, 1993). Learning is said to have taken place when attitudes

are changed, knowledge is increased, or skill is improved as measured by the test (Willyerd, 1997:53). Tests are popular because they are easy to develop and administer, and because they produce variance in trainees' scores (Goldsmith and Kraiger, 1997:74).

The impact of learning on job performance, although not strong, has been demonstrated. A meta-analysis of 34 studies using Kirkpatrick's learning criteria revealed a moderate correlation between three categories of learning and on-the-job performance (r's =. 08-.18; Alliger et al., 1997:349). The relationship between learning and reaction (utility judgments) is also moderate (r's = .02-.26; Alliger et al., 1997:349) These correlations indicate that although a trainee may score well on a test of learning, superior training performance in terms of learning does not always guarantee comparable performance on the job. A study by Severin (1959) found that training did not always accurately represent performance on-the-job and should not be substituted for studies of on-the-job performance without first determining that a strong relationship exists (Goldstein, 1974: 60). Nevertheless, measures of learning criteria provide a means of assessing trainee learning throughout a training course and provide some indicator of on-the-job-performance.

Behavior is Kirkpatrick's third criteria and is defined as the extent to which a person's behavior changes due to attending training (Willyerd, 1997:53; Kirkpatrick, 1977:9). Although training programs can facilitate knowledge acquisition (learning), there may be a large gap between knowing facts or principles and demonstrating them on the job. It is possible for trainees to do well on performance tests administered during training, yet not be able or willing to exhibit these same skills on their jobs. In other words, there is no transfer of learning to the job (Wexley and Latham, 1991:119). If the

purpose of a training program is to produce on-the-job performance improvement (Goldstein, 1974:3), on-the-job performance criteria are vital to measuring performance improvement after training, or transfer of training. Typically, transfer is assessed by measuring the maintenance and generalization of trained skills after the trainee has been on the job for some time (Baldwin and Ford, 1988). In the Air Force ISD model, operational evaluation of on-the-job performance after training is the critical element for assessing the effectiveness of training programs (AFMAN 36-2234, 1993:104).

Evaluation of results, Kirpatrick's fourth criteria, can be stated in terms of cost-related objectives that provide a dollar value of training (Wexley and Latham, 1991:120). Results are defined as the impact of training on organizational objectives such as profits, production, quality, etc. (Kirkpatrick, 1977:9). The concept of utility is synonymous with results evaluation and assesses the training program in terms of its cost versus its benefits in financial terms (Cascio, 1989). A utility analysis is important because it is possible for a training program to bring about favorable reactions, increase trainee learning, change employee behavior on-the-job, and improve cost-related results. It is also possible that such a training program may still not be worth implementing in an organization because it is not cost-effective. Due to the focus of this study, results criteria were not examined.

Based on the above discussion, the following propositions are advanced:

P1: Information technology training increases a trainee's reactions, learning, and performance.

P2: The better a trainee's reactions to IT training, the higher a trainee's learning.

P3: The better a trainee's reactions to IT training, the better a trainee's performance.

The value and impact of the Kirkpatrick training evaluation model can not be understated. Its pervasive use in industry makes it a practical choice for evaluating training programs. Despite this, little work has been done to evaluate information technology training courses with validated MIS constructs using the Kirkpatrick framework. To further develop this point, the next section will describe several MIS constructs, how they might integrate into the Kirkpatrick framework, and what results might be expected when evaluating IT training programs using MIS constructs.

Modifying the Kirkpatrick Framework to Accommodate MIS Constructs and IT Training

It is a commonly held axiom that user training is a key element in MIS success (Galletta, Ahuja, Hartman, Teo, and Peace, 1995:70). A study by Nelson and Cheney (1987) showed that IT can have a significant positive impact on an individual's job performance if the firm provides adequate training. User training has been found to influence attitudes toward an information system, and user training programs are also likely to increase user confidence in their ability to master and use computers in their work (Igbaria, Guimaraes, and Davis, 1995:92). In addition, previous MIS researchers have focused on user attitudes, behavior, and performance as ways of measuring IS success. Many attitudinal or judgment measures have been proposed for IT success such as user satisfaction (DeLone and McLean, 1992:60), user expectations (Ginzberg, 1981:459), user motivation (Olfman and Bostrom, 1991:249), and user ability (Lee et al., 1995:192). All have found varying degrees of support in the MIS literature. In this study, however, particular attention will be paid to four MIS constructs that have proven effective in measuring the relationship of IT training to attitudes toward IT and prediction

of IT usage. These constructs are computer self-efficacy, perceived usefulness, perceived ease of use, and computer attitude. After defining each measure and describing possible interrelationships among them, a modified Kirkpatrick model is presented that hypothesizes probable relationships among traditional Kirkpatrick training criteria and the MIS measures.

Theoretical Background. Social Cognitive Theory, as first espoused by Bandura (1977) advances two sets of expectations as major cognitive forces guiding behavior. The first set of expectations relates to outcomes. Individuals are more likely to undertake behaviors they believe will result in valued outcomes. The second set of expectations encompasses what Bandura (1977) calls self-efficacy, or beliefs about one's ability to perform a particular behavior. Self-efficacy influences choices about which behaviors to undertake, the effort and persistence exerted in the face of obstacles to the performance of those behaviors, and ultimately the mastery of those behaviors.

Computer Self-Efficacy. Computer self-efficacy, a judgment of one's capability to use a computer, derives its theoretical foundation from Albert Bandura's self-efficacy work (Murphy, Coover, and Owen, 1989:893). The self-efficacy construct is well-established and is described as "judgments about how well one can organize and execute courses of action required to deal with prospective situations containing many ambiguous, unpredictable, and often stressful elements" (Bandura and Schunk, 1981:587). Self-efficacy perceptions have been found to influence decisions about what behaviors to undertake (Bandura, Adams, and Beyer, 1977), the effort exerted and persistence in attempting those behaviors (Brown and Inouye, 1978), the emotional responses of the individual performing the behaviors (Stumpf, Brief, and Hartman, 1987),

and the actual performance attainments of the individual with respect to the behavior (Locke, Frederick, Lee, and Bobko, 1984; Wood and Bandura, 1989). From an MIS perspective, several studies have examined the relationship between self-efficacy with respect to using computers and a variety of computer behaviors (e.g. Burkhardt and Brass, 1990; Hill et al, 1987). These and other studies found a relationship between self-efficacy and performance in software training (Gist, Schwoerer, and Rosen, 1989; Webster and Martocchio, 1992; 1993) as well as learning (Martocchio, 1994:824). Self-efficacy measures, including computer self-efficacy, provide the strongest predictive results when applied to specific activities such as education or skill training (Murphy et al., 1989:894). Computer self-efficacy measures can then be used, for instance, to predict and evaluate performance in training (Murphy et al., 1989:894). Using C2IPS as the target system, this leads to the following hypothesis.

H1: There will be a significant positive increase in a trainee's computer self-efficacy following C2IPS training.

H2: There will be a significant positive relationship between a trainee's computer self-efficacy and trainee learning on C2IPS.

H3: There will be a significant positive relationship between a trainee's computer self-efficacy and trainee performance on C2IPS.

Perceived Ease of Use. In his developmental work on the Technology Acceptance Model, Davis (1989) linked self-efficacy to a "perceived ease of use" construct in developing a model to explain user acceptance of IT. He claimed that PEOU is related to self-efficacy in that both notions capture judgments of how well someone performs the actions required when faced with a particular situation (Davis,

1989:321). Although PEOU is related to self-efficacy, the construct captures more than this. Davis (1989) states that PEOU also captures instrumentality of computer use. For example, improvements in ease of use may save effort, enabling a person to accomplish more work for the same effort (Davis, 1989:987). Davis defines perceived ease of use as the degree to which the prospective user expects the target system to be free of effort (Davis, Bagozzi, and Warshaw, 1989:987). The easier a system is to interact with, the greater should be the user's sense of efficacy regarding his or her ability to carry out the tasks required to operate the system. Applying this reasoning to information technology training, then, perceived ease of use might increase a trainee's sense of self-efficacy as well as on-the-job performance. Some preliminary support suggests a possible training to perceived ease of use relationship. Igabaria et al. (1995) found that user training correlated significantly with perceived ease of use ($r = .43$, $p > .001$). From these results, it seems reasonable to expect training to positively impact perceived ease of use and a subsequent increase in trainee performance on the information system. However, little has been done to investigate the link between perceived ease of use and learning. This study provides such an opportunity. Given the above discussion, the following hypotheses are advanced.

H4: The will be a significant positive increase in a trainee's perceived ease of use of C2IPS following C2IPS training.

H5: There will be a significant positive relationship between a trainee's perceived ease of use of C2IPS and trainee learning on C2IPS.

H6: There will be a significant positive relationship between a trainee's perceived ease of use of C2IPS and trainee performance on C2IPS.

Perceived Usefulness. The second aspect of Social Cognitive Theory, outcomes, has been examined by Davis (1989). It is linked to Fishbein and Aizen's Theory of Reasoned Action (1975). Davis (1989) regards his measure of perceived usefulness as a measure of IT success. Perceived usefulness is defined as the prospective user's subjective probability that using a specific computer system will increase his job performance within an organizational context (Davis et al., 1989:985). Davis states that "Bandura's 'outcome judgment' variable is similar to perceived usefulness." In other words, individuals are more likely to choose behaviors (using a computer) they believe will result in valued outcomes (Davis, 1989:321). Perceived usefulness was originally defined as part of an adaptation of Fishbein and Aizen's (1975) Theory of Reasoned Action. In this theory, performance of a specified behavior is determined by the behavioral intention to perform the behavior. Intentions are determined by the person's attitude and subjective norm concerning the behavior in question. Similarly, perceived usefulness is a perceptual construct and is hypothesized to impact a trainee's attitude toward using a computer. This, in turn, influences intentions to use a computer and subsequent computer usage. If perceived usefulness predicts computer usage, it may also predict trainee performance after receiving training on the system. A study linking training to perceived usefulness by Igabaria et al. (1995) found that user training correlated significantly with perceived usefulness ($r = .28$, $p < .001$). Given these results it seems reasonable to expect that training may positively impact other MIS success constructs as well as eventual trainee performance using the information system. Given this discussion, the following hypotheses are proposed.

H7: There will be a significant positive increase in a trainee's perceived usefulness of C2IPS following C2IPS training.

H8: There will be a significant positive relationship between a trainee's perceived usefulness of C2IPS and trainee learning.

H9: There will be a significant positive relationship between a trainee's perceived usefulness of C2IPS and trainee performance on C2IPS.

Computer Attitudes. In the final analysis, all of the constructs described contribute toward the formation of broad attitudes toward using computers. It follows then, that a measure of overall attitudes toward computers should relate in some form to these constructs. When described in terms of the Theory of Reasoned Action, computer attitudes affect users' behavioral intentions which affect users' actual usage of computers (Rainer and Miller, 1996:94). Also, Davis showed that the sum of PEOU and PU correlated significantly with changes in attitude toward using a computer (Davis, 1989:994). It seems reasonable to expect that if a training program can change neutral or negative attitudes toward computers into positive attitudes, a trainee's subsequent on-the-job performance may be increased. Igbaria and Parasuraman (1991) cite evidence that user training is positively related to user computer attitudes ($r = .28$, $p < .001$). Although no study has been done on the relationship between computer attitude and on-the-job performance, the organizational behavior literature is replete with studies relating job attitudes to job performance. For example, Noe and Schmitt (1986) report that job attitudes influence learning and behavior change as a result of training. In addition, Iaffaldano and Muchinsky (1985) performed a meta-analysis on the relationship between job satisfaction (a "job attitude") and job performance. They found a positive correlation

between the two measures (r =. 17, p = .05). Petty, McGee, and Cavender (1984) meta-analyzed the satisfaction and performance literature and found a stronger positive correlation between the two variables (r = .31). Although job attitudes and job satisfaction are broader attitudinal constructs than computer attitude, it would not be unreasonable to expect computer attitudes to influence on-the-job performance in a fashion similar to the satisfaction-performance relations described above. Changes in computer attitudes as a result of information technology training may be a good predictor of performance. Therefore, the following hypotheses are advanced.

H10: There will be a significant positive increase in a trainee's computer attitude following C2IPS training.

H11: The will be a significant positive relationship between a trainee's computer attitude and trainee learning.

H12: There will be a significant positive relationship between a trainee's computer attitude and trainee performance on C2IPS.

The Relationship of MIS Constructs to On-the-Job Performance. MIS research has focused primarily on IT acceptance and usage (e.g. Davis, 1989; Lee, et al., 1995; Igabaria, et al., 1995; Snead and Harrell, 1994; Burton, Chen, Grover, and Stewart, 1993; Compeau and Higgins, 1995) rather than on on-the-job performance using the system. Usage has been defined in various ways, but most measures rely on self-reports of the amount of time spent on a computer or software package per day (Igbaria et al., 1995; Lee, et al, 1995). These measures of usage are satisfactory if amount of time spent on a computer is the measure of IT success. However, most training programs have in mind a behavioral change that positively impacts an employee's performance (Noe and Schmitt,

1986:497). Use of a computer does not necessarily mean that an individual is performing job related tasks at an acceptable level.

Performance has been characterized in many ways: objectively, subjectively, in terms of quality and quantity of work, and in terms of self-reports, supervisor ratings, and peer ratings. All methods have their drawbacks (Ianffaldano and Muchinsky, 1985:252; Cascio, 1991:73). However, behaviorally-based measures focused on performance of computer related tasks may provide an adequate link between IT training and on-the-job performance. Behaviorally-based measures of computer performance provide the rater with a series of descriptive statements of job-related behavior. The task of the rater in this situation is to indicate how well the ratee performs the behavior in question (Cascio, 1991:86).

In the Air Force, training programs are developed around job performance requirements through the process of job and task analysis (Air Force Manual 36-2234 1993:35). Task performance captures the performance domain that differentiates one job from another but excludes important performance elements common to most jobs (Van Scotter and Motowidlo, 1996:525). This study focuses on the "technical core" of C2IPS job performance, or, in other words, task performance in using C2IPS. Linking MIS success constructs to behaviorally-based computer performance ratings can add a new dimension to this relationship. Figure 5 depicts the modified Kirkpatrick IT training model and shows in pictorial form the hypotheses outlined above.

Supervisor and Self-Rating of Performance for Training. Measuring performance after training is the most desirable way of assessing a training program's effectiveness (Ghodsian, Bjork, and Benjamin, 1997:84). One common method

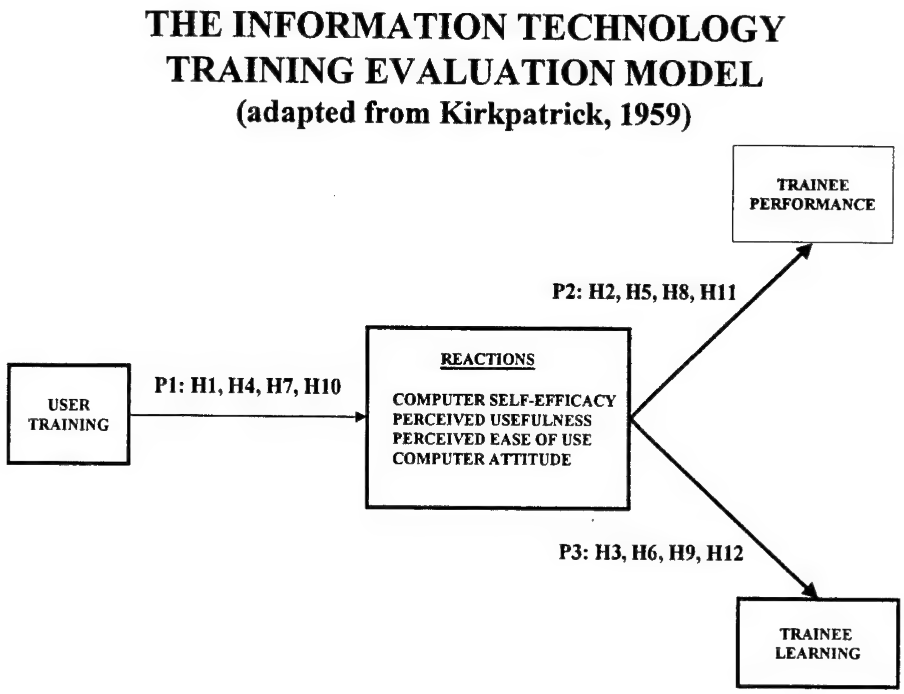


Figure 4. Modified Kirkpatrick Evaluation Framework for IT Training

of assessing performance in organizations is performance appraisal. Performance appraisal involves two distinct processes: (1) observation and (2) judgment (Cascio, 199:77). Observation processes are more basic, and include the detection, perception, and recall or recognition of specific behavioral events. Judgment processes include the categorization, integration, and evaluation of information (Thornton and Zorich, 1980). Observation and judgment represent the last elements of a three-part sequence of job analysis, performance standards, and performance appraisal. Job analysis identifies the components of a particular job, performance standards translate job requirements into levels of acceptable/unacceptable performance, and performance appraisal describes the job relevant strengths and weaknesses of each individual (Cascio, 1991:77).

Job analysis, among other functions, helps determine how personnel are to be trained and what criteria will be used to measure job performance (Cascio, 1991:189).

Performance ratings must be based on a systematic job analysis, and they should be behaviorally based in order to meet technical standards and legal precedents (Nathan and Cascio, 1986). For the purpose of this study, job analysis is important, as it is the foundation for both C2IPS training content and the performance measure used to detect C2IPS training effects.

Given the importance of performance appraisals for an individual's career and in rating increases in performance due to training, who performs the appraisal is vital. Raters must have direct experience with, or firsthand knowledge of the individual to be rated (Cascio, 1991:84). Several different sources of performance rating have been used including the immediate supervisor, peers, subordinates, self-appraisal, and customer appraisal. In this study, supervisor and self-appraisal are used, therefore the remainder of this discussion will focus on these two performance appraisal methods.

Up to 93% of appraisal programs make the immediate supervisor the rater (Bernadin and Beatty, 1984). The main reason for this is that the supervisor is assumed to be the person with the most opportunity to observe the individual and his/her changes in performance. In addition, the supervisor is probably best able to evaluate each subordinate's performance in light of the organization's overall objectives (Cascio, 1991:78). In some settings, participants' supervisors may be more familiar with other factors that could produce performance improvements. It's simple, inexpensive, and fairly credible because the information comes from the "horse's mouth"-in this case, the supervisors of people who received the training. Research has shown that feedback from supervisors is more highly related to performance than from any other source (Becker and Klimoski, 1989). With regard to human resource programs in organizations (e.g.

training), reliable measurement of performance is often a main indicator of effectiveness (Viswesvaran, Ones, and Schmidt, 1996:558). As such, it is important to have an idea of the reliability of these ratings.

Several analyses of supervisor ratings have been reported. A study by Viswesvaran, et al. (1996) reported the interrater reliability of supervisory ratings and overall job performance to be r = .52. In addition, a meta-analysis by Conway and Huffcutt (1997) reported a relationship of r = .50. These correlations indicate a fairly strong relationship between supervisor ratings and overall job performance. Although higher correlations are desirable, supervisor ratings continue to be the prime source of performance ratings. They are utilized in this study.

In some cases, supervisor performance appraisal can be supplemented by self-appraisal. Because an individual is no doubt familiar with the tasks of the job, it seems reasonable to let an individual judge his or her own job performance. Their actions have produced the performance improvements, so they should have some idea of how much improvement has been made as a result of their training. In addition, self-appraisals provide an accessible source of individual performance data (Hoffman, Nathan, and Holder, 1991:605). Also, management tends to find such reports credible because participants are at the center of the improvement. Participants' input can be obtained by asking the following questions:

- What percent of the improvement can be attributed to the application of skills, techniques, or knowledge gained in the training?
- What is the basis for your estimation?
- What degree of confidence do you have in your estimation?

- What other individuals or groups could make an estimation?
- What other factors do you think contributed to the improvement?

The opportunity to participate in performance appraisal, especially when combined with goal setting, should improve an individual's motivation and performance (Latham and Locke, 1979; Mento, Steel, and Karran, 1987). However, comparisons of self-appraisals with those of supervisors, peers, and subordinates suggest that self-appraisals tend to show more leniency, less variability, more bias, and less agreement with the judgments of others (Harris and Schaubroek, 1988:55). To some extent, these disagreements may stem from the tendency of raters to base their ratings on different aspects of job performance or to weight facets of job performance differently (Steel and Ovalle, 1984:668). Self-raters place emphasis on personal skill and technical competence while supervisors stress output and results criteria (Zammuto, London, and Rowland, 1982).

With regard to training, Golembiewski and Billingsley (1980) report three types of change associated with pre-, post-, and on-the-job self-report data: gamma change, beta change, and alpha change. Gamma change shifts the frame of reference of the trainee as a result of training (Cascio, 1991:407). This means that trainees think about a behavior in a totally different way than before training. Beta changes adjust the measurement scale before and after training (Cascio, 1991:407). Whereas performance on a task may have been classified by the trainee as "above average" before training, after training that same behavioral performance may become "average". Alpha change is the actual change in behavior over time with respect to a stable research instrument and a constant training situation (Cascio, 1991:407).

A technique for accounting for changes other than alpha changes when obtaining self-reports has been developed by training practitioners. The technique is called "Pre-Then-Post Testing" and is designed to account for response-shift bias or bias associated with trainees overestimating abilities, skills, and so on (Mezoff, 1981:57). Mezoff states that conventional pre-post testing tends to be inaccurate because participants' frame of reference is often different at the beginning and end of training (gamma change or response-shift bias). To make legitimate pre-post comparisons, a non-biased "Pre-" measure is obtained after the training by asking the trainee to reflect back to his/her level of functioning prior to the training and then re-rate him/herself (Mezoff, 1981:59). This response is called the "Then" measure and is used to evaluate training effects in lieu of the original "Pre-" measure. The "Pre-Then-Post" technique for correcting self-report bias has been addressed in the research with generally positive results (e.g. Howard, 1980; Howard, Schmeck, and Bray, 1979). In addition, its ease of administration and adaptation for survey use as well as its potential for legitimately documenting the effects of training make it of practical use when collecting self-reports. It is used in this study.

In addition, other research shows that self-appraisals may be given more validity if certain techniques are utilized (Mabe and West, 1982:293). First, instead of asking individuals to rate themselves on an absolute scale, Mabe and West's findings (1982) suggest that a relative scale that allows them to compare their performance with that of others will improve data quality. This technique tends to yield closer agreement between self- and supervisor ratings (Farh and Dobbins, 1989). Second, provide multiple opportunities for skill appraisal. The skill may improve with practice (Cascio, 1991:80). Third, provide reassurance of confidentiality (Cascio, 1991:80). Confidentiality may

promote honesty in rating. Fourth, allow personnel to "readjust" their performance assessment given the results of training. A person's frame of reference may change as a result of training thereby promoting a more realistic assessment of skills.

Interestingly, research indicates that data from multiple sources are desirable because they provide a complete picture of the individual's effect on others (Wohlers and London, 1989). Credibility seems to rise when supervisors' estimates are combined with participants' estimates and when a confidence level is factored in (Phillips, 1996). Other studies cite advantages such as enhanced ability to observe and measure various job facets (Borman, 1974; Henderson, 1984), greater reliability, fairness, and ratee acceptance (Latham and Wexley, 1982).

Conway and Huffcutt (1997) report that the number and types of raters can affect the quality of rating systems. They state that "multiple raters are often available…this means that quality of ratings can be improved…" (Conway and Huffcutt, 1997:346). A central thesis is that different raters provide a unique perspective on performance (Conway and Huffcutt, 1997:349). However, they state that increasing reliability increases validity only to the extent that the performance measures in question possess validity (Conway and Huffcutt, 1997:346). Therefore, using the results of job analysis and targeting specific behaviors in the rating process is critical. A meta-analysis by Harris and Schaubroek (1988) reported a correlation of $r = .35$ between supervisor and self ratings of job performance. In terms of mean differences, self-ratings have been found to be consistently higher than supervisory ratings (Harris and Schaubroek, 1988:55; Conway and Huffcutt, 1997:342-344; Hoffman, et al., 1991:610). The reason for this difference has been attributed to an egocentric bias in self-ratings of performance

(Harris and Schaubroek, 1988:55; Conway and Huffcutt, 1997:351). Despite this inherent inflation of self-ratings of performance, self-appraisals may prove highly correlated with other measures of performance when performance measures are verifiable and specific (Farh, Werbel, and Bedeian, 1988). When coupled with supervisory ratings, they may add credibility to the overall performance assessment.

The ease of obtaining supervisory and self-ratings of performance for research purposes is a salient reason for their use. More importantly, reliability of these ratings must be taken into account when analyzing performance changes as a result of training. However, a research design that incorporates valid and specific measures of task performance along with simple interventions designed to increase self-report reliability can help offset inherent deficiencies in such ratings. With due consideration for these factors, supervisory and self-ratings can be of practical benefit when evaluating training.

Summary

Chapter II summarized the literature relevant to this study's hypotheses and research design. The insights gathered from this literature review will be integrated and applied in the following chapter of this report. In particular, Chapter III will describe how the constructs described above are operationalized and explain the research design and procedures used to evaluate them.

III. Method

Chapter Overview

This chapter describes and justifies the research method used to test the hypotheses presented in Chapter II. First, the research design and method are outlined. Next, the independent variables used in this study are operationalized. Procedures for data collection, analysis, and measurement are also presented, including the results of a pilot test.

Research Design

Research design is a plan for selecting the sources and types of information used to answer the primary research questions (Cooper and Emery, 1995:114). The design sets the framework for the relationships between the variables of the study and outlines procedures beginning with the hypotheses and concluding with analysis of the data gathered (Cooper and Emery, 1995:114).

Once training evaluation criteria are identified, a successful evaluation hinges on a choice of appropriate design for assessing the training program (Goldstein, 1974:24). For training evaluation, appropriate designs follow from clear elucidation of the purpose of the evaluation, what is to be evaluated, and how the evaluation is to be performed. Rigorous evaluation designs are essential to avoid incomplete evaluation, invalid results, or simplistic interpretation of results (Newstrom, 1978:22). Characteristics of a good design include reliability, validity, and relevancy and must be built into the design to ensure credibility for effective management decision-making (Salinger and Deming,

1982:20). Campbell and Stanley (1963) describe three types of designs and their concomitant reliability and validity including pre-experimental designs, true experimental designs, and quasi-experimental designs. Although true experimental designs provide the best overall validity (Campbell and Stanley, 1963:8), organizational constraints may preclude such designs. Quasi-experimental designs provide the best chance for achieving reliable and valid results while accommodating the demands of the organizational situation.

Since the nature of military work precludes random assignment of subjects and, hence, a true experimental design and because of the difficulty associated with coordinating three separate C2IPS training courses, the use of a quasi-experimental design is the best option for this study. Over the period of the study, multiple classes were taught in each course, some simultaneously, at different locations. Given the researchers other duties and lack of funds, it was deemed impractical to travel to each training class to conduct experiments. In addition, a limited trainee population, a finite number of training courses, and time constraints were also factors contributing to the use of a quasi-experimental design. The quasi-experimental design used in this study can be categorized as a variation of a time-series quasi-experimental design. It is shown in figure 6. Data were collected longitudinally a total of three times for each C2IPS training class: once at the beginning of the class, once at the end of the class, and once on-the-job.

The advantage of a longitudinal study is that it can track changes over time (Cooper and Emery, 1995:116). For this study, measurement of multiple training classes serves to overcome some of the validity problems associated with the relatively small number of measurements over time. If results are consistent across the sample

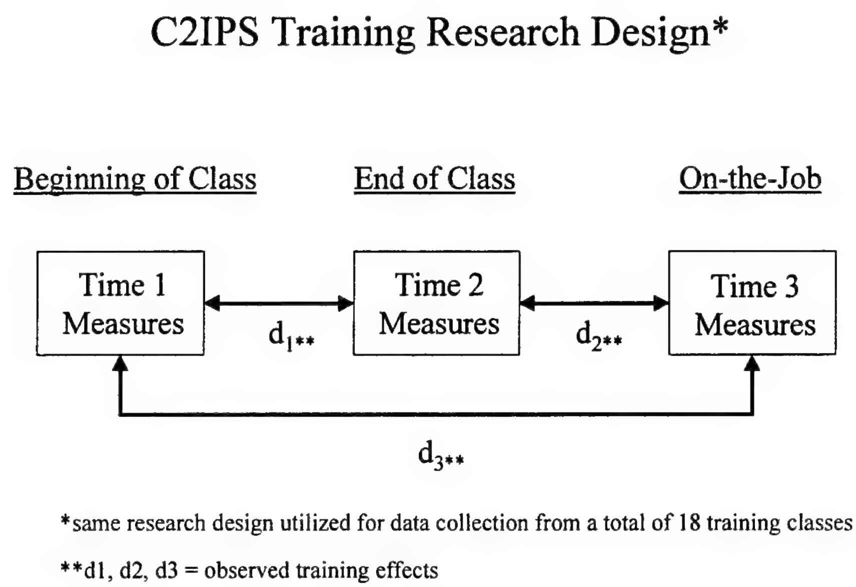


Figure 5. C2IPS Training Research Design

and classes, then validity of the design and the results are enhanced. In addition, a formal study was selected based on the need to define research questions, formulate hypotheses, specify data sources, and develop precise procedures for collection and analysis of research results. Data were collected using a survey method. The following section describes the sample for this study in more detail.

Sample

Surveys were administered at three separate C2IPS training organizations: the Air Mobility Warfare Center located at Fort Dix, New Jersey and the 333rd and 335th Training Squadrons located at Keesler AFB, Mississippi. Copies of the surveys used in this study are contained in Appendix E. The Air Mobility Warfare Center C2IPS course is six weeks long and is designed to teach students the responsibilities of air mobility command

and control, including the understanding and operation of C2IPS. The 333rd Training Squadron provides in-depth C2IPS system administrator training over a period of six weeks, and gives personnel comprehensive understanding of how C2IPS works and how to maintain the system. Finally, the 335th Training Squadron delivers one-week C2IPS orientation operator courses to Air Force, Air National Guard, and Air Reserve bases throughout the world. The 335th C2IPS course is unique in that instructors travel to various Air Force bases to deliver the class whereas the Air Mobility Warfare Center and 333rd courses were given at their respective locations. The 335th class is not comprehensive but does provide instruction for the basic, fundamental operation of C2IPS.

The sample population included a total of 218 military, civilian, and contractor personnel from throughout the Air Force who either operate or maintain C2IPS. Although most of the sample population was enlisted, some officer and senior civilian personnel were also represented in the sample. The Air Mobility Warfare Center sample consisted of 4 C2IPS operator classes given between February and June 1998 for a total of 56 students. The 333rd sample consisted of 3 C2IPS system administrator classes given between February and June 1998 for a total of 15 students. The 335th sample consisted of 12 C2IPS operator classes given between February and May 1998 for a total of 147 students.

Measures

The measure of computer self-efficacy used in this study, the 10-item computer self-efficacy scale, was developed by Compeau and Higgins (1995). As reported by

Compeau and Higgens, the computer self-efficacy scale achieved an internal consistency of .95. Therefore, they report the computer self-efficacy scale as highly reliable. The scale consists of ten questions, each reflecting some aspect of computer self-efficacy. For each question, respondents are asked to judge their ability to use a software package by answering "yes" or "no". If a respondent answers "yes", they are then asked to rate the confidence of their judgment on a scale of 1 to 10 with 1 meaning "not at all confident", 5 meaning "moderately confident", and 10 meaning "totally confident". For the purposes of this research, the scale was modified slightly to reflect the type of training being studied (C2IPS) and constraints regarding data collection procedures. The most significant change was eliminating the "yes/"no" criterion, and changing the response scale to 1 to 9 instead of 1 to 10. These changes were made to simplify reporting and achieve consistency across measurement scales. The measure of computer self-efficacy is derived by adding the scores on each of the computer self-efficacy items and dividing by ten (i.e. the number of items) to provide an overall index of computer self-efficacy.

The perceived ease of use scale (Davis, 1989) yielded a Cronbach alpha of .93. The perceived ease of use scale consists of four items. The respondent is asked to indicate the degree of his/her perceived ease of use of a system on a 7-point Likert scale. A response of 1 indicates strongly disagree, 4 indicates neutral (neither agree nor disagree), 7 indicates strongly agree. The scale was modified to reflect the use of C2IPS as the target system. The measure of perceived ease of use is derived by adding the scores on each of the perceived ease of use items and dividing by four (i.e. the number of items) to provide an overall index of perceived ease of use.

The perceived usefulness scale used in this study has demonstrated strong reliability and internal consistency. Davis (1989) obtained a Cronbach alpha of .97. The perceived usefulness scale consists of four items indicative of the construct. The respondent is asked to indicate the degree of his/her perceived usefulness of a system on a 7-point Likert scale. A response of 1 indicates strongly disagree, 4 indicates neutral (neither agree nor disagree), and 7 indicates strongly agree. As with computer self-efficacy and perceived ease of use, the perceived usefulness scale was modified to reflect the use of C2IPS as the target system. Individual measures of perceived usefulness are derived by adding the scores on each of the perceived usefulness items and dividing by four (i.e. the number of items) to provide an overall index of perceived usefulness.

The computer attitude scale used in this study has yielded a Cronbach alpha of .87 in earlier research (Taylor and Todd, 1995:156). The computer attitude scale consists of 4 items reflecting the computer attitude. Respondents are asked to indicate their computer attitude by responding to a 7-point Likert-type scale. Unlike perceived ease of use and perceived usefulness, each question has a different response scale. Examples of scale anchors include "Bad" to "Good" and "Dislike" to "Like". The computer attitude scale was modified to reflect the use of C2IPS as the target system. Individual measures of computer attitude are derived by adding the scores on each of the computer attitude items and dividing by four (i.e. the number of items) to provide an overall index of computer attitude.

Learning measures were collected from the Air Mobility Warfare Center. Tests were developed by the training staff and are directly related to course content. No reliability measures were available for the tests nor was the data set available to provide

further analysis of unidimensiality. However, measures of learning often use the overall percentage score on academic tests. Thus, the researcher felt that this measure represented a valid measure of learning.

The performance appraisal instrument used in this study was based on Air Mobility Command job performance requirements for AMC command and control personnel and system administrator personnel. Job performance requirements are derived using a number of processes and techniques including formal occupational measurement by the Air Education and Training Command Occupational Measurement Squadron and subject matter expert panels (Cascio, 1991:203) involving Air Force and major command function career field managers and training managers. Based on this job analysis, AMC developed a comprehensive list of behaviorally based performance statements thought to include the scope of tasks required for successful C2IPS operation and C2IPS system administration, for example. The primary result of this process is the AMC Command Post/Air Mobility Control Center Controller Job Performance Requirements List (AMC/DOOC, 1997:7). This list provides the basis for on-the-job training on C2IPS. The thorough nature of the AMC job analysis process lends more validity to the Job Performance Requirements List as tool for both building a training program and evaluating performance (Cascio, 1991:189). All C2IPS training courses use at least some form of the applicable Job Performance Requirements List to develop course content thereby providing an effective link between training, practice, and measurement of on-the-job performance changes as a result of C2IPS training.

The C2IPS Operator performance scale consisted of 24 items related to C2IPS Operator task behaviors. Each item was anchored by a 5-point Likert scale with a

response of 1 indicating "Performs Well Below Average", 3 indicating "Performs Average", and 5 indicating "Performs Well Above Average" as compared to their peers. The C2IPS System Administrator performance scale consisted of 23 items related to C2IPS System Administrator task behaviors. A 5-point Likert scale identical to the C2IPS Operator scale was used. In addition, one item was added to both performance scales asking the trainee to indicate overall C2IPS performance. This item also used the same 5-point Likert scale. Individual measures of performance are derived by adding the response magnitudes of each item on the performance scale and dividing by the total number of items on the scale.

Procedures

Longitudinal data were gathered from three C2IPS training courses to track effects of training over time. Surveys of each training group measured trainee computer self-efficacy, perceived ease of use, perceived usefulness, computer attitude, and self-reported performance at the beginning of the training course, at the end of the training course, and on the job. In addition, a measure of trainee on-the-job performance using C2IPS was provided by each trainee's supervisor. For all studies, the "Pre-Then-Post" technique (see Chapter II) for reducing self-report bias was employed. This technique, coupled with behaviorally-specific performance statements and reliable MIS measurement instruments was used to increase the quality of self-report performance data.

All trainees completed self-report measures of computer self-efficacy, perceived ease of use, perceived usefulness, computer attitude, and self-rated performance using

C2IPS at the beginning of the class (time 1), end of the class (time 2), and on-the-job (time 3). In addition, trainee supervisors completed a post-training survey of on-the-job performance for the trainee. Surveys were administered by C2IPS training personnel during the course, and on-the-job surveys were mailed to the trainee and the trainee's supervisor. Academic tests were administered as a measure of learning by the Air Mobility Warfare Center. The Air Mobility Warfare Center utilized pre- and post-tests.

Finally, a variety of demographic data were collected including Rank, Grade, Enlisted Skill Level, Age, Gender, Type of Organization, Self-Reported Usage of C2IPS, and Previous Experience on C2IPS. Although not explicitly part of the C2IPS training model, these data were collected with regard to the relationship they might have with increases in performance and to provide a description of the sample. Type of Organization indicated whether the trainee works in a base level, numbered air force, MAJCOM, or other organization. Self-Reported Usage of C2IPS was a measure of how much time the trainee perceived he/she spent on C2IPS on any given day. Self-Reported Usage was measured in hours using a 6-point scale where, for example, a response of 1 meant "no time spent on C2IPS", 3 meant "1-3 hours spent on C2IPS per day," etc. Previous Experience on C2IPS reported the amount of months the trainee had worked with C2IPS before attending the training course

Pilot Study

A pilot study of survey instrumentation was conducted using the responses of 20 Air Force Institute of Technology graduate students. Based on the feedback from the pilot study, several changes to the survey were made to facilitate readability, comprehension, and speed of completion. Modified versions of the surveys were sent to

the Air Force Personnel Center's Survey Control Office. After minor wording changes, the surveys were approved for this study and assigned a Survey Control Number of USAF SCN 98-33.

Statistical Analysis and Guidelines for Evaluating Hypothesis

Statistical Analysis. The data collected from C2IPS training course surveys are analyzed using a variety of statistical techniques including descriptive statistics, reliability analysis, factor analysis, normality tests, t-tests, and multiple regression. Descriptive statistics such as means and standard deviations are used to prepare the data for further analysis and provide a general idea of the relationships between variables. Test-retest reliability analysis using Cronbach's alpha is performed to determine the stability of the computer self-efficacy, perceived ease of use, perceived usefulness, computer attitude, and performance instruments when given to the trainees at each stage of the study to assess the impact of changes made to the scales. Factor analysis is used to verify the overall construct validity and acceptability of the survey items.

Evaluation of Propositions and Analysis of Hypotheses. Although the above analyses are straightforward, the variety and number of training classes as well as the longitudinal nature of this study makes evaluating hypotheses in terms of statistical results more complex. For instance, if a hypothesis using a variable is significant at the end of training but not on-the-job, is the hypothesis supported or not? Despite this quandary, suitable evaluation guidelines can be developed using statements from the discussion of training presented in Chapter II that will help classify whether or not a hypothesis is supported. Chapter II stated that the focus of the Air Force evaluation is to ensure that training programs ensure that graduates acquire the skills, knowledge, and

attitudes to do the job; that these graduates meet job performance requirements; and to identify ways to improve the graduate's performance (AFI 36-2201:7). In addition, Wexley and Latham (1991) and Goldstein (1974) state that transfer of training is crucial. Using these statements as a framework, three basic guidelines can be developed.

Guideline 1: increases in performance, learning, and attitudes as a result of training are desirable.

Guideline 2: the transfer to the job of performance, learning, and attitudes that were higher than trainee had before training is desirable. In terms of relative importance, guideline 2 is more important than guideline 1.

Guideline 3: factors that influence trainee performance during training and on the job are desirable.

Hypotheses related to proposition 1, whether or not training increases attitudes, learning, and performance, will be evaluated using paired t-test. Under the terms of guidelines 1 and 2, these hypotheses will be fully supported if they show a transfer effect. In statistical terms, this means that paired t-tests will be significant either from time 1 (beginning of training) to time 3 (on-the-job) or from time 2 (end of training) to time 3. Hypotheses related to proposition 1 will be partially supported if they show only a training effect. Statistically, this means that paired t-tests will be significant only from time 1 to time 2.

Hypotheses related to propositions 2 and 3 will be analyzed using stepwise linear regression. These propositions ask whether computer self-efficacy, perceived usefulness, perceived ease of use, and computer attitude influence learning and performance. Guideline 3 is therefore appropriate for evaluating these hypotheses. In terms of

guideline 3, this means that a variable that predicts performance as part of a linear regression model is desirable. In statistical terms, hypotheses related to propositions 2 and 3 will be fully supported if the regression model is significant (F-value) and the variable in the regression model is significant (t-value).

Longitudinal Assessment of Variables Using Linear Regression. One of the benefits of a longitudinal study is that changes in variables over time may be assessed. Multiple paired t-tests like those described above provide such an opportunity, but the same idea using linear regression much be approached a bit more systematically. Specifically, the impact of independent variables as measured at a previous time in the study (time 1, for instance) to predict the dependent variable as measured at a later time (time 3) would give an idea of the robustness of the independent variable in predicting the dependent variable. In other words, if the independent variable remains significant (provided the regression models are significant) over time, then it may be viewed as a reliable predictor of the dependent variable. Chapter IV implements this idea using 3 linear regression equations with learning as the dependent variable and 6 linear regression equations with self-rated performance as the dependent variable. Table 1 shows the list of equations.

Table 1. Linear Regression Equations

Time 1 Learning =Time 1 Computer Self-Efficacy+Time 1 Perceived Usefulness +Time 1 Perceived Ease of Use+Time 1 Computer Attitude+Usage

Time 2 Learning=Time 1 Computer Self-Efficacy+Time 1 Perceived Usefulness +Time 1 Perceived Ease of Use+Time 1 Computer Attitude+Usage

Time 2 Learning=Time 2 Computer Self-Efficacy+Time 2 Perceived Usefulness +Time 2 Perceived Ease of Use+Time 2 Computer Attitude+Usage

Time 1 Performance=Time 1 Computer Self-Efficacy +Time 1 Perceived Usefulness +Time 1 Perceived Ease of Use+Time 1 Computer Attitude+Usage

Time 2 Performance=Time 1 Computer Self-Efficacy+Time 1 Perceived Usefulness +Time 1 Perceived Ease of Use+Time 1 Computer Attitude+Usage

Time 2 Performance=Time 2 Computer Self-Efficacy+Time 2 Perceived Usefulness +Time 2 Perceived Ease of Use+Time 2 Computer Attitude+Usage

Time 3 Performance=Time 1 Computer Self-Efficacy+Time 1 Perceived Usefulness +Time 1 Perceived Ease of Use+Time 1 Computer Attitude+Usage

Time 3 Performance=Time 2 Computer Self-Efficacy+Time 2 Perceived Usefulness +Time 2 Perceived Ease of Use+Time 2 Computer Attitude+Usage

Time 3 Performance=Time 3 Computer Self-Efficacy +Time 3 Perceived Usefulness +Time 3 Perceived Ease of Use+Time 3 Computer Attitude+Usage

IV. Results

Chapter Overview

Chapter IV presents the analysis and results of the C2IPS training surveys administered to the 335th Training Squadron, Air Mobility Warfare Center, and 333rd Training Squadron. First, the sample size, demographics, and distribution of responses will be discussed. Next, the reliability analysis of the survey scales will be presented. The hypotheses related to Proposition 1, involving the relationship between training and trainee reactions, are discussed using the results of paired t-tests of key variables. In addition, the means of on-the-job self-rated and supervisor-rated performance are compared using an independent t-test. Then, the outcomes of hypothesis related to Proposition 2, the relationship between trainee reactions and trainee learning, is described using the results of linear regression analyses. Finally, hypotheses related to Proposition 3, the relationship of trainee reactions and trainee performance, is similarly presented in terms of the results of linear regression analyses. Conclusions based on these results will be presented in Chapter V.

Survey Results

General Demographics. C2IPS training surveys (Appendix B) were administered to 207 military, civilian, and contractor personnel. As seen in Table 2, the 335th Training Squadron had by far the most participants while the 333rd Training Squadron has the smallest number of participants. All surveys were reviewed for completeness and usability. Of particular note is the fact that data from 10 trainee surveys from the Air Mobility Warfare Center survey were unusable due to faulty survey completion. These

10 trainees used the beginning of course survey instead of the end of course survey to register their responses on the end of their training class. To collect on-the-job measures (time 3), surveys were sent to 169 of the 207 trainees and their supervisors. Surveys were not sent to all trainees and supervisors due to the constraints placed on timely data collection and the completion of this report. A total of 52 usable trainee surveys were returned for a response rate of 31%, and a total of 26 supervisor surveys were returned for a response rate of 15.5%. Additional histograms and normality plots of selected variables are contained in Appendix A. All calculations were performed using SPSS® Graduate Pack 8.0 for Windows.

Table 2. Sample Size by Course and Class

335th		Air Mobility Warfare Center		333rd	
Class 1	15	Class 1	18	Class 1	10
Class 2	15	Class 2	15	Class 2	5
Class 3	10	Class 3	3	**TOTAL**	**15**
Class 4	7	Class 4	9		
Class 5	12	**TOTAL**	**45**		
Class 6	13				
Class 7	9				
Class 8	6				
Class 9	13				
Class 10	19				
Class 11	10				
Class 12	18				
TOTAL	**147**				

OVERALL SAMPLE SIZE = 207

To build a picture of the overall survey sample, Tables 3 through 9 provide frequency statistics from the study's demographic variables. It should be noted that although the overall sample size was 207, sample sizes for many of the demographic variables do not equal 207. This can be attributed to omissions on the survey response sheets, obvious

errors (e.g. out-of-range responses), and indeterminate responses (e.g. multiple responses for the same item).

As shown in Table 3, enlisted personnel comprised the overwhelming majority of the sample at 72%. Officers, civilians, and contractor personnel were evenly distributed at about 8% each. This distribution is expected because most C2IPS operators and system administrators are enlisted personnel.

Table 3. Frequencies Based on Rank

RANK

Category	Frequency	Percent
Enlisted	150	72
Officer	17	8
Civilian (WG)	3	1
Civilian (GS)	15	7
Contractor	17	8
Other	2	1
Total	204	

Table 4 shows that, for enlisted personnel, all skill levels were relatively evenly represented. However, based on the proportion of enlisted personnel in Table 3, there is some degree of error in Table 3. In Table 3, the total number of enlisted is 150. Therefore, 3-, 5-, and 7-level frequencies should total 150. As seen in Table 4, they do not. As such, this information should be viewed with some skepticism.

Most respondents were between the ages of 20 and 30 (52%) followed by ages 31 to 40 (27%). This ratio is generally consistent with Air Force demographic statistics for age ranges of its personnel (Air Force Personnel Center, 1998).

Table 4. Frequencies Based on Enlisted Skill Level

ENLISTED SKILL LEVEL

Category	Frequency	Percent
3-Level	44	21
5-Level	60	29
7-Level	59	28
N/A	40	19
Total	203	

Table 5. Frequencies Based on Age

AGE

Category	Frequency	Percent
Under 20	14	7
20 to 30	107	52
31 to 40	55	27
41 to 50	20	10
51 to 60	7	3
Over 60	1	0
Total	204	

As with age, gender is again consistent with Air Force gender ratios of approximately 82% male to 18% female (Air Force Personnel Center, 1998).

Table 6. Frequencies Based on Gender

GENDER

Category	Frequency	Percent
Male	152	72
Female	49	23
Total	201	

In addition, Table 7 shows that Wing and Base level C2IPS personnel comprised the overwhelming majority of participants. "Other" organizations included contractor companies and Air Force Reserve units. Numbered Air Force and Major Command respondents rounded out the rest of the sample. C2IPS systems are predominately fielded at Wing and Base level organizations with a much smaller proportion fielded at the Numbered Air Force and Major Command level. Therefore, one would expect the majority of C2IPS personnel to work in Wing and Base level organizations.

Table 7. Frequencies Based on Organization

ORGANIZATION

Category	Frequency	Percent
Wing/Base	139	67
NAF	9	4
MAJCOM	17	8
Other	36	17
Total	201	

Also, it is not surprising that most trainees had little or no previous experience with C2IPS (76%). This is to be expected from a training course (see Table 8).

Table 8. Frequencies Based on Previous C2IPS Experience

PREVIOUS C2IPS EXPERIENCE

Category	Frequency	Percent
None	97	47
1 to 6 Months	61	29
7 to 12 Months	18	9
> 12 Months	23	11
Total	199	

Similarly, Table 9 demonstrates that most trainees perceived that they used C2IPS less than 3 hours during the duty day (74%). For these personnel, C2IPS may serve as only a part of their overall duties. In contrast, the remaining 22% of trainees perceived they used C2IPS for more than 4 hours per day. For these personnel, C2IPS may be viewed as the predominant function of their job.

Table 9. Frequencies Based on Self-reported usage of C2IPS

SELF-REPORTED USAGE OF C2IPS		
Category	Frequency	Percent
None	76	37
< 1 hour	40	19
1 to 3 hours	37	18
4 to 6 hours	24	12
7 to 8 hours	20	10
> 8 hours	4	2
Total	201	

Scale Reliabilities. Calculations on all variable scales produced acceptable levels of internal consistency, as shown in Table 10. In addition, Cronbach Alphas were generally consistent with values obtained from previous research, as described in Chapter II. Based on the Cronbach Alphas, items measuring specific constructs can be assumed to have high internal consistency and are able to produce consistent results over time with successive administrations (Cooper and Emery, 1995:153). The C2IPS performance scales were particularly noteworthy for their high reliabilities (α = .96-.99). In addition, a factor analysis using all items from the computer self-efficacy, perceived usefulness, perceived ease of use, computer attitude, and self-rated performance scales was performed (results are contained in Appendix B). The factor analysis showed that all variable items appeared to factor into distinct categories representing the constructs

purported to be captured by the variable scales. However, the results should be viewed with caution due to the small sample size to item ratio. Experts generally agree that the ratio for a reliable factor analysis should be around 10:1. The ratio for this study was 207 respondents to 45 items or about 4.6:1.

Table 10. Scale Reliabilities, All Courses: Time 1 and Time 2

VARIABLES: CRONBACH ALPHAS BY COURSE	Time 1	Time 2	Time 3
Computer Self-Efficacy:			
Overall (All Courses)	.94	.93	.94
335th	.93	.94	X
AMWC	.94	.92	X
333rd	.96	.96	X
Perceived Usefulness:			
Overall (All Courses)	.92	.94	.96
335th	.91	.94	X
AMWC	.94	.93	X
333rd	.84	.96	X
Perceived Ease of Use:			
Overall (All Courses)	.85	.81	.86
335th	.84	.85	X
AMWC	.86	.65	X
333rd	.79	.90	X
Computer Attitude:			
Overall (All Courses)	.92	.90	.89
335th	.92	.92	X
AMWC	.92	.83	X
333rd	.92	.94	X
Self-Report Performance:			
Overall (All Courses)	.99	.97	.97
335th	.99	.96	X
AMWC	.99	.97	X
333rd	.99	.97	X
Rater On-the-Job Performance Eval (Time 3 Only):			
Overall (All Courses)	X	X	.9823

Proposition 1. Information technology training increases a trainee's reactions, learning, and performance.

Paired t-tests were performed for Computer Self-Efficacy, Perceived Usefulness, Perceived Ease of Use, Computer Attitude, Learning, and Performance measures to determine the relationship of training on these variables over time and to determine the supportability of Proposition 1 and its related hypothesis. Comparisons were made

between Time 1 (Beginning of Course) and Time 2 (End of Course), Time 2 and Time 3 (On-the-Job), and Time 1 and Time 3. Hypotheses related to Proposition 1 are evaluated in terms of these comparisons.

As a precautionary measure, an independent t-test was conducted between Time 3 self-rated performance and supervisor-rated performance to determine if any bias existed in either of the ratings. Based on the literature examined in Chapter II, subordinates have been reported to systematically inflate their performance ratings as compared to those of their supervisors. Therefore, if the t-test detects no significant difference, then self-rated performance indexes can be assumed to be a fairly reliable measure of C2IPS performance following training and, by extension, during training.

Table 11 shows t-tests comparing Time 1 and Time 2 scores for each C2IPS course. Based on the number of participants in each course, the variables measured in each course were either significant or showed a trend toward increased significance. For example, although all 333rd relationships were not significant, the magnitudes of significance are likely attributed to the low number of participants (N = 15). It is reasonable to assume that a higher N would yield comparable levels of significance. Therefore, aside from the results presented in Table 10, all future analyses will utilize a combined measure of all cases from the three training courses. More detailed discussions of hypotheses related to Proposition 1 follow.

Hypothesis 1: *There will be a significant positive increase in a trainee's computer self-efficacy as a result of C2IPS training.*

The results of the overall paired t-test from time 1 to time 2 (Table 12) show an increase in computer self-efficacy from an average of 50.85 at time 1 to 66.01 at time 2

(t = -12.19, p < .001). However, no significant change was detected between time 2 and time 3 meaning computer self-efficacy stayed at the same level when the trainee returned to the job (Table 13). Although no increase was detected after the end of training, computer self-efficacy still showed a significant increase from time 1 to time 3 from 50.00 to 65.10 (t = -6.29, p < .001) as seen in Table 14. Therefore, Hypothesis 1 is therefore supported.

Hypothesis 4: *There will be a significant positive increase in a trainee's perceived ease of use of C2IPS following C2IPS training.*

As Table 12 shows, perceived ease of use increased from a score of 17.35 at time 1 to 20.15 at time 2 (t = -11.54, p < .001). Like computer self-efficacy, no significant change in the level of perceived ease of use was noted between time 2 and time 3 (Table 13). This means perceived ease of use remained the same after the trainee resumed his/her normal duties. However, Table 14 shows that the change from time 1 to time 3 remained significant (t = -5.04, p < .001). As a result, Hypothesis 4 is supported.

Hypothesis 7: *There will be a significant positive increase in a trainee's perceived usefulness of C2IPS as a result of C2IPS training.*

Perceived usefulness of C2IPS was higher at time 2 (22.40) than at time 1 (20.12). In addition, the relationship was significant at the .001 level (Table 12). However, from time 2 to time 3, dropped from 22.40 to 20.98 (t= 2.14, p < .05). This drop resulted in a score that was similar to the score obtained from the trainee at the beginning of the training course: 20.92 at time 1 vs. 20.98 at time 3. So, although training temporarily boosted perceived usefulness immediately following training, the increase was not sustained when the trainee returned to the job. Therefore, Hypothesis 7 was partially supported.

Table 11. Paired t-tests, Time 1 and Time 2: Grouped by Variable and Course

Overall (All Courses)

Variable	Time 1 Mean	Time 1 Std. Dev	Time 2 Mean	Time 2 Std. Dev	df	t
Computer Self-Efficacy	50.85	18.33	66.01	16.03	202	-12.19***
Perceived Usefulness	20.12	5.84	22.40	5.71	203	-6.092***
Perceived Ease of Use	17.35	5.49	20.15	6.08	203	-11.536***
Computer Attitude	19.93	5.30	22.10	4.95	202	-6.712***
Self-Report Performance	2.67	1.17	3.92	0.70	200	-18.375***

335th

Variable	Time 1 Mean	Time 1 Std. Dev	Time 2 Mean	Time 2 Std. Dev	df	t
Computer Self-Efficacy	52.75	17.86	67.14	16.29	143	-9.88***
Perceived Usefulness	20.37	5.70	22.45	5.57	144	-3.03***
Perceived Ease of Use	17.84	5.39	21.01	5.31	144	-8.33***
Computer Attitude	20.32	5.26	22.36	5.00	143	-5.27***
Self-Report Performance	2.74	1.17	3.96	0.72	142	-15.50***

Air Mobility Warfare Center

Variable	Time 1 Mean	Time 1 Std. Dev	Time 2 Mean	Time 2 Std. Dev	df	t
Computer Self-Efficacy	45	18.9413	61.98	15.63611	43	-6.01***
Perceived Usefulness	19.64	6.7795	22.3	6.245294	43	-3.63***
Perceived Ease of Use	16.8	5.719186	17.48	7.656852	43	-0.58***
Computer Attitude	19.24	5.89744	21.89	4.95663	43	-3.73***
Self-Report Performance	2.423	1.180927	3.807	0.657898	42	-8.73***
Learning	32.61	17.56714	86.28	7.937654	17	-11.27***

333rd

Variable	Time 1 Mean	Time 1 Std. Dev	Time 2 Mean	Time 2 Std. Dev	df	t
Computer Self-Efficacy	49.93	18.37	67.00	13.34	14	-3.76**
Perceived Usefulness	19.13	4.00	21.53	5.18	14	-1.38
Perceived Ease of Use	14.13	4.79	19.27	5.15	14	-3.06**
Computer Attitude	18.13	2.77	20.20	4.28	14	-1.92*
Self-Report Performance	2.78	1.08	3.82	0.50	14	-4.58**

* Significant at $p < .1$
** Significant at $p < .01$
*** Significant at $p < .001$

Hypothesis 10: *There will be a significant positive increase in a trainee's computer attitude following C2IPS training.*

Table 12 shows that computer attitude increased from time 1 to time 2 ($t = -6.712$, $p < .001$). Like perceived usefulness, however, this increase did not transfer to the job and in fact fell to the same level reported by the trainee at the beginning of the training course: 20.56 at time 1 vs. 20.98 at time 3 (t-test non-significant) as seen in Table 14. As a result, Hypothesis 10 was partially supported.

Figure 7 summarizes the paired t-tests for each variable in graphical format. The lines represent the percentage increase or decrease in each variable over time. From the figure, the dramatic increases in self-rated performance, computer self-efficacy, and perceived ease of use are clearly shown. In addition, the rise and fall of perceived usefulness and computer attitude over time is easily seen.

Table 12. Overall Paired t-tests, Time 1 and Time 2: Grouped by Variable

	Overall (All Courses)					
	Time 1		Time 2			
Variable	Mean	Std. Dev	Mean	Std. Dev	df	t
Computer Self-Efficacy	50.85	18.33	66.01	16.03	202	-12.19***
Perceived Usefulness	20.12	5.84	22.40	5.71	203	-6.092***
Perceived Ease of Use	17.35	5.49	20.15	6.08	203	-11.536***
Computer Attitude	19.93	5.30	22.10	4.95	202	-6.712***
Self-Report Performance	2.67	1.17	3.92	0.70	200	-18.375***

* Significant at $p < .001$

Table 13. Overall Paired t-tests, Time 2 and Time 3: Grouped by Variable

	Overall (All Courses)					
	Time 2		Time 3			
Variable	Mean	Std. Dev	Mean	Std. Dev	df	t
Computer Self-Efficacy	63.51	18.04	65.49	15.52	48	-.679
Perceived Usefulness	22.71	5.90	20.98	6.80	48	2.144*
Perceived Ease of Use	21.82	4.38	21.77	5.20	48	.055
Computer Attitude	22.98	4.13	20.92	4.82	48	2.919**
Self-Report Performance	3.97	.6626	3.68	.88	48	2.501*

* Significant at $p < .05$
** Significant at $p < .001$

Table 14. Overall Paired t-tests, Time 1 and Time 3: Grouped by Variable

	Overall (All Courses)					
	Time 1		Time 3			
Variable	Mean	Std. Dev	Mean	Std. Dev	df	t
Computer Self-Efficacy	50.00	19.40	65.10	15.60	49	-6.29*
Perceived Usefulness	20.92	6.55	20.98	6.74	49	-.081
Perceived Ease of Use	18.1	5.56	21.82	5.16	49	-5.04*
Computer Attitude	20.56	5.28	20.98	4.79	49	-.68
Self-Report Performance	2.74	1.30	3.68	.88	45	-6.07*

* Significant at $p < .001$

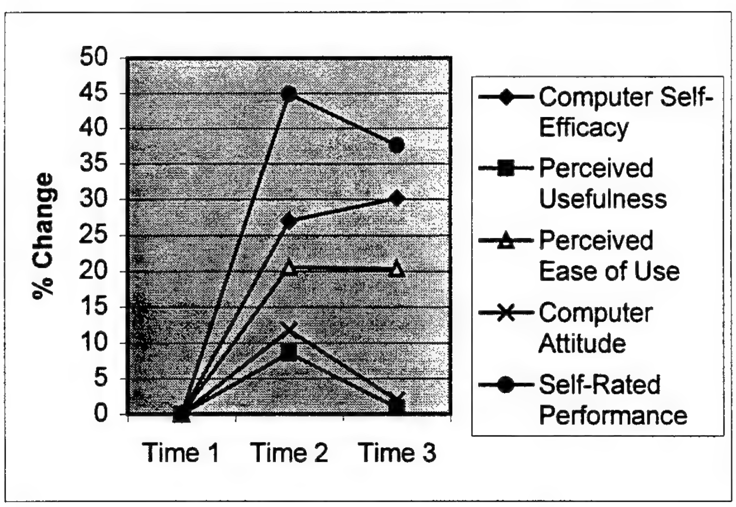


Figure 6. Percent Change in Reactions and Performance Over Time

Performance and Learning. Next, increases in performance and learning were analyzed using paired t-tests. Although increases in these relationships were not explicitly hypothesized for this study, it is useful to analyze the data if only to lend credibility to the C2IPS training effort and this research.

As seen in Table 12, self-rated performance on C2IPS showed a dramatic increase from time 1 to time 2 of ($t = -18.38$, $p < .001$). From time 2 to time 3, self-rated performance dropped from 3.92 to 3.68 ($t = 2.50$, $p < .05$) between the end of the training course and on-the-job. However, when compared with beginning of course performance levels and on the job performance levels, self-rated performance increased significantly from 2.74 to 3.68 ($t = -6.07$, $p < .001$).

Learning also showed a dramatic increase over time. As Table 11 shows, trainees scored an average of 32.61% on the beginning of the course academic test compared with an average of 86.28% at the end of the course test (t - -11.27, $p < .001$).

In addition, an independent t-test of time 3 on-the-job self-rated performance measures and on-the-job supervisor-rated performance measures was performed. This test was conducted to show if there were differences in the way trainees and supervisors perceived performance on C2IPS following training. Previous research has indicated a systematic inflationary bias when subordinates rate their performance as compared to their supervisors. An independent t-test yielding a significant difference would mean that bias occurred while a non-significant difference would mean that trainees and supervisors rated performance on C2IPS in a similar manner.

As shown in Table 15, trainee and supervisor C2IPS performance ratings showed no significant difference ($t = -.01$, $p = .99$). In fact, trainees and supervisors rated C2IPS

performance nearly identically. Based on this result, trainee self-report C2IPS performance measures are assumed to be credible measures and valid surrogates of C2IPS performance.

Table 15. Independent t-test, Time 3: Comparison of On-the-Job Self-Rated Performance and On-the-Job Supervisor-Rated Performance

	On-the-Job Supervisor Rated Performance	On-the-Job Self-Rated Performance
Mean	3.63	3.63
Variance	0.94	0.86
Observations	26	49
Pooled Variance	0.89	
Hypothesized Mean Difference	0	
df	73	
t	-0.01	
P(T<=t), two-tail	0.99	
t Critical, two-tail	1.99	

Proposition 2. The higher a trainee's reactions to IT training, the higher the trainee's learning.

Hypothesis 2: *There will be a significant positive relationship between a trainee's computer self-efficacy and trainee learning on C2IPS.*

Hypothesis 5: *There will be a significant positive relationship between a trainee's perceived ease of use of C2IPS and trainee learning on C2IPS.*

Hypothesis 8: *There will be a significant positive relationship between a trainee's perceived usefulness of C2IPS and trainee learning.*

Hypothesis 11: *There will be a significant positive relationship between a trainee's computer attitude and trainee learning.*

The Air Mobility Warfare Center provided the only opportunity to examine this proposition and its associated hypotheses, as it was the only course to offer beginning and end of course academic knowledge testing. In addition, because pre- and post- testing of trainees was just getting underway, disparities in test administration yield a total of 18

cases at time 1 and 34 cases at time 2. Three multiple regression analyses were performed using results of academic knowledge test scores (learning) as the dependent variable and four independent variables contained in the hypotheses. Therefore, proposition 2 and its hypotheses were not supported.

(NOTE: As Table 16 shows, none of the three regression models were significant at an α =.1 level. Since none of the models and variables were significant at the α =.1 level, p-values for the models and variables are not shown in Table 16.)

Proposition 3. The higher a trainee's reactions to IT training, the better the trainee's on-the-job performance.

Hypothesis 3: *There will be a significant positive relationship between a trainee's computer self-efficacy and trainee performance on C2IPS.*

Hypothesis 6: *There will be a significant positive relationship between a trainee's perceived ease of use of C2IPS and trainee performance on C2IPS.*

Hypothesis 9: *There will be a significant positive relationship between a trainee's perceived usefulness of C2IPS and trainee performance on C2IPS.*

Hypothesis 12: *There will be a significant positive relationship between a trainee's computer attitude and trainee performance on C2IPS.*

A battery of stepwise linear regressions was performed with computer-self efficacy, perceived usefulness of C2IPS, perceived ease of use of C2IPS, computer attitude, and self-reported usage of C2IPS using self-rated performance as the dependent variable. Regressions used the combined results of all C2IPS courses (N=203) based on the argument developed for the paired t-test analyses above (e.g. each training course produced similar training results). Also, self-rated performance was used as the dependent variables. It has been demonstrated by the independent t-test between self-rated and supervisor-rated measures of performance that self-rated performance is a

Table 16. Linear Regression Results: AMWC C2IPS Academic Knowledge Test (Learning) as Dependent Variable

	Learning, Time 1	
	R^2	F
Model Statistics	.267	1.185
Variable	ß	t
Computer Self-Efficacy, Time 1	.278	1.088
Perceived Usefulness, Time 1	-.290	-.861
Perceived Ease of Use, Time 1	.248	.914
Computer Attitude, Time 1	.345	1.020
	Learning, Time 2, Model 1	
	R^2	F
Model Statistics	.191	1.828
Variable	ß	t
Computer Self-Efficacy, Time 1	.063	.715
Perceived Usefulness, Time 1	.485	.107
Perceived Ease of Use, Time 1	-.595	.021
Computer Attitude, Time 1	-.117	.680
	Learning, Time 2, Model 2	
	R^2	F
Model Statistics	.033	.256
Variable	ß	t
Computer Self-Efficacy, Time 2	.096	.604
Perceived Usefulness, Time 2	.056	.830
Perceived Ease of Use, Time 2	-.132	.601
Computer Attitude, Time 2	-.073	.786

reasonable indicator of C2IPS performance. In addition, the fact that the quantity of self-rated performance measures (N=207) yields more degrees of freedom and statistical power than supervisor-report performance measures (N=26) supports the use of self-rated performance measures. Correlations between regression variables were not used for this analysis but nonetheless are contained in Appendix C.

As shown in Table 17, the first regression used beginning of course (time 1) self-rated performance as the dependent variable and yielded a model with an F-value of 32.61 ($p < .001$) and an R-squared value of .34. Three significant predictors were produced: computer self-efficacy, perceived ease of use, and self-reported usage.

Perceived usefulness and computer attitude were not significant. Of the 3 significant predictors, computer self-efficacy had the highest Beta-weight at .37 followed by perceived ease of use (.24) and self-reported usage (.15). All predictors were significant at the $p < .001$ level.

Next, two regression models were produced using end of course self-rated performance (time 2) as the dependent variable. The first model used time 1 independent variables to predict performance at time 2. Table 18 shows that the model was significant ($F = 30.15$, $p < .001$). The R-squared value dropped to .23 as compared to .34 at time 1.

Interestingly, computer self-efficacy and perceived ease of use still showed a capacity to predict end-of course self-rated performance. The next regression model utilized time 2 independent variables to predict end of course performance. The results

Table 17. Linear Regression Results at Time 1: Beginning of Course Self-Rated Performance as Dependent Variable

	All Courses Combined Using Time 1 Independent Variables					
Variable(s) Included	R^2	ΔR^2	F	Δ F	β	t
Computer Self-Efficacy, Time 1	0.27	0.27	70.93***	70.93	0.37	5.54*
Perceived Ease of Use, Time 1	0.31	0.05	44.37***	13.33	0.24	3.58*
Self-reported usage	0.34	0.02	32.61***	6.54	0.15	2.56*
Variable(s) Excluded						
Perceived Usefulness	-	-	-	-	.069	.995
Computer Attitude	-	-	-	-	.102	1.430

* Significant at $p < .001$

were almost identical to the beginning of course regression model described above. As Table 18 shows, the model was significant with an F-value of 32.96 ($p < .001$). The R-squared value of .34 was identical to the beginning of course model. In addition, predictor variables were identical: perceived ease of use ($\beta = .37$, $p < .001$), computer

self-efficacy (β = .29, $p < .001$), and self-reported usage (β = .13, $p < .001$). Similarly, computer attitude and perceived usefulness failed to provide significant information.

Table 18. Linear Regression Results at Time 2: End of Course Self-Rated Performance as Dependent Variable

			All Courses Combined Using Time 1 Independent Variables			
Variable(s) Included	R^2	ΔR^2	F	Δ F	β	t
Computer Self-Efficacy, Time 1	0.18	0.18	42.41**	42.41	0.29	4.12**
Perceived Ease of Use, Time 1	0.23	0.06	30.15**	14.92	0.27	3.86**
Variable(s) Excluded						
Perceived Usefulness, Time 1	-	-	-	-	-.029	-.399
Computer Attitude	-	-	-	-	.054	.704
Self-reported usage	-	-	-	-	.091	1.413
			All Courses Combined Using Time 2 Independent Variables			
Variable(s) Included	R^2	ΔR^2	F	Δ F	β	t
Perceived Ease of Use, Time 2	0.25	0.25	63.81**	63.81	0.37	5.86**
Computer Self-Efficacy, Time 2	0.32	0.08	46.32**	21.94	0.29	4.59**
Self-reported usage	0.34	0.02	32.96**	4.54	0.13	2.13*
Variable(s) Excluded						
Perceived Usefulness, Time 2	-	-	-	-	.078	1.116
Computer Attitude	-	-	-	-	.117	1.440

* Significant at $p < .05$
** Significant at $p < .001$

A final set of three regressions were performed using on-the-job self-rated performance (time 3) as the dependent variable (Table 19). The first regression used time 1 variables to predict performance and was significant ($F = 8.44$, $p < .001$) with an overall R^2 of .38. In this model computer self-efficacy (β = .36, $p < .1$), perceived usefulness (β = .22, $p < .05$), and self-reported usage (β = .23, $p < .05$) served as significant predictors of performance. The second model used time 2 variables as predictors. This model was also significant with an F-value of 10.31 ($p < .001$) and an R^2 =.33. In this model, end-of-course self-rated performance (β = .31, $p < .1$), self-reported usage (β = .32, $p < .05$) and perceived usefulness (β = .25, $p < .05$) served as predictors.

Table 19. Linear Regression Results at Time 3: On-the-Job Self-Rated Performance as Dependent Variable

	All Courses Combined Using Time 1 Independent Variables					
Variable(s) Included	R^2	ΔR^2	F	Δ F	ß	t
Computer Self-Efficacy, Time 1	.28	.28	17.12****	17.12	.36	2.51*
Perceived Usefulness, Time 1	.34	.06	10.83****	3.54	.22	1.69**
Self-reported usage	.38	.04	8.44****	2.78	.23	1.67**
Variable(s) Excluded						
Perceived Ease of Use, Time 1	-	-	-	-	-.05	-.27
Computer Attitude	-	-	-	-	.086	.47
	All Courses Combined Using Time 2 Independent Variables					
Variable(s) Included	R^2	ΔR^2	F	Δ F	ß	t
Self-Rated Performance, Time 2	.26	.26	15.00****	15.00	.31	2.29*
Self-reported usage	.35	.21	11.30***	5.90	.32	2.48**
Perceived Usefulness, Time 2	.41	.12	9.32****	3.90	.25	1.97*
Variable(s) Excluded						
Computer Self-Efficacy, Time 2	-	-	-	-	-.026	-.19
Perceived Ease of Use, Time 2	-	-	-	-	-.16	.094
Computer Attitude	-	-	-	-	-.20	-1.25
	All Courses Combined Using Time 3 Independent Variables					
Variable(s) Included	R^2	ΔR^2	F	Δ F	ß	T
Perceived Usefulness, Time 3	.25	.25	14.27****	14.27	.45	3.82****
Self-reported usage	.41	.16	14.81****	11.84	.41	3.44****
Variable(s) Excluded						
Perceived Ease of Use, Time 3	-	-	-	-	.108	.702
Computer Attitude, Time 3	-	-	-	-	-.082	-.45
Computer Self-Efficacy, Time 3	-	-	-	-	.18	1.51

*	Significant at $p < .1$
**	Significant at $p < .05$
***	Significant at $p < .01$
****	Significant at $p < .001$

The final model used time 3 variables as predictors of performance and was the most statistically significant model with an F-value of 14.81 ($p < .001$) and R^2 of .41. Like the first two models, perceived usefulness ($\beta = .45$, $p < .001$) and self-reported usage ($\beta = .41$, $p < .001$) proved to be the most significant indicators of performance.

Of note is the fact that the time 3 regressions using on-the-job performance consistently produced perceived usefulness as a significant variable in predicting performance. On the other hand, time 1 and time 2 regressions using beginning and end

of course performance resulted in computer self-efficacy and perceived ease of use as indicators of performance.

Also of note is that self-reported usage is the only variable that significantly predicted performance during all times of the study. Given the guidelines established in Chapter III, this consistency in the ability of the usage variable to predict performance better at different times enhances its reliability as a predictor of performance.

Table 20 shows a summary of the linear regression models and significant predictor variables at time 1, time 2, and time 3. Based on these results, hypotheses 3 and 6 were partially supported because computer self-efficacy and perceived ease of use were positively related to performance at time 1 and time 2 but not at time 3. Similarly, hypothesis 9 was partially supported because of the ability of perceived usefulness to predict performance at time 3 but not at time 1 and time 2. Finally, hypothesis 12 was not supported due to the inability of computer attitude to predict performance at any time. These findings will be further examined in the following chapter.

Table 20. Summary of Linear Regression Models at Times 1, 2, and 3

	Time 1 Performance	Time 2 Performance	Time 3 Performance
Model R^2, Time 1 Variables	.34	.23	.38
Model R^2, Time 2 Variables		.34	.41
Model R^2, Time 3 Variables			.41
Variables	β	β	β
Computer Self-Efficacy, Time 1	.37	.29	.36
Computer Self-Efficacy, Time 2		.29	-
Computer Self-Efficacy, Time 3			-
Perceived Ease of Use, Time 1	.24	.27	-
Perceived Ease of Use, Time 2		.37	-
Perceived Ease of Use, Time 3			-
Perceived Usefulness, Time 1	-	-	.23
Perceived Usefulness, Time 2		-	.25
Perceived Usefulness, Time 3			.45
Computer Attitude, Time 1	-	-	-
Computer Attitude, Time 2		-	-
Computer Attitude, Time 3			-
Self-Reported Usage, Time 1	.15	-	.23
Self-Reported Usage, Time 2		.13	.32
Self-Reported Usage, Time 3			.41

Summary

Chapter IV presented the results and analysis of the data compiled for this study. Proposition 1 and its related hypotheses partially supported a significant increase in trainee reactions and performance as a result of information technology training. Proposition 2 was not supported meaning that a significant relationship between trainee reactions and learning was not found. Finally, proposition 3 was partially supported. From the beginning to the end of training, computer self-efficacy, perceived ease of use of C2IPS, and self-reported usage of C2IPS were significantly related to C2IPS performance increases. For on-the-job performance, perceived usefulness of C2IPS, and self-reported usage of C2IPS consistently predicted C2IPS performance. In Chapter V, the impact and significance of these findings will be discussed along with the limitations of the study, conclusions, recommendations based on the findings, and implications for future practice and research.

V. Discussion

Chapter Overview

In Chapter IV, results and analysis of this study's data was presented. Chapter V will now discuss the significance of the findings, identify limitations of the research, and offer conclusions and recommendations. In addition, implications for future research are outlined.

Significance of Findings

Proposition 1. There will be a significant positive increase in trainee reactions following C2IPS training.

The key insight regarding this proposition is that C2IPS training does appear to increase trainee reactions, learning, and performance during training. Further, most of these increases are transferred to the job. Results of this study show a 30% increase in computer self-efficacy, a 16% increase in perceived ease of use, a 165% increase in learning, and a 47% increase in performance from the beginning of training and when the trainee resumes his/her normal duties. These results indicate that C2IPS training is successful in producing more effective and productive C2IPS operators and system administrators.

Key stakeholders in the training process should view these results positively. Trainees receive crucial skills needed to perform in the workplace, and supervisors in Air Mobility Command field organizations receive more productive personnel. Supervisors can use these variables to assess whether or not an individual should be sent to training and as a measure of performance improvement after training. Air Education and Training

Command training instructors can be confident that their training curriculum and techniques are effective in producing skilled C2IPS personnel. Increases and decreases in variables could provide an indication of trainee progress and notify decision-makers of the impact of C2IPS training on performance. Air Mobility Command training resource providers can use these impacts to assess whether funding, staff, and facilities investments are yielding returns and to establish investment criteria. This investment could include the development of new information technology training methods by the Air Force Research Laboratory. By using the surveys developed for this study, the Air Force research laboratory could assess whether techniques for increasing training performance using a new system actually work before recommending the system future acquisition. For the Air Force, then, the cost of C2IPS training is worth the benefit received in the form of support to "Global Reach" and "Information Dominance".

Although some variables can be used to great effect by supervisors, training instructors, and resource providers, use of perceived usefulness and computer attitude should be viewed with caution. These variables returned to their original beginning of course levels despite the increase attributed to C2IPS training. From an academic standpoint, the resiliency of trainee usefulness perceptions and computer attitudes may indicate that these constructs are more closely related to value judgements that have been established over a long period of exposure to computer systems like C2IPS. According to the Theory of Reasoned Action (Fishbein and Aijzen, 1974), value judgments are less likely to be influenced by temporary interventions such as training. In addition, perceived usefulness and computer attitude may encompass a broader view of the work context. Since C2IPS training is focused on a narrow aspect of the trainee's work

domain, the training may "tap into" only a part of the entire usefulness and attitude constructs as viewed by the trainee. In addition, the job environment may, in fact, be the place where the trainee derives the strongest support and cues for his/her usefulness perceptions and computer attitudes. These may, in turn, "override" the training increases and cause the trainee to return to his/her original levels.

Proposition 2. The better a trainee's reactions to IT training, the higher the trainee's learning.

None of the reaction variables supported a relationship to trainee learning. A couple of explanations may clarify why this result occurred. First, the sample size may have been too low to detect any effects due to only one training course utilizing C2IPS academic knowledge testing. Second, there may have been no relation between the reaction variables and the material tested. At a minimum, computer self-efficacy should have predicted trainee learning due to the strong literature supporting the self-efficacy-to-learning link. Perhaps, repeating this part of the study with a larger sample size and a more detailed review of test materials may yield significant results. Even though this relationship was not supported for this study, it should not be dismissed as unimportant. At the least, training instructors should request more thorough investigation into the learning-performance relationship.

Proposition 3. The better a trainee's reactions to IT training, the better the trainee's on-the-job performance.

As observed in Chapter IV, some variables predict performance better at different times. Performance associated with training (beginning and end of course self-rated performance in this case) are predicted better by computer self-efficacy and perceived

ease of use. Conversely, on-the-job performance is predicted better by perceived usefulness. Computer attitude was not effective in predicting performance at all, but self-reported usage was the only variable effective in predicting both training and on-the-job performance. Before discussing the practical importance of these results, the disparity in the ability of variable to predict performance at different times deserves discussion.

As Table 19 showed, computer self-efficacy, perceived ease of use, and self-reported usage were relatively stable in explaining the variance associated with performance throughout C2IPS training. The fact that both the time 1 and time 2 regression models had R^2 values of .34 also contributes to the argument of stability. Clearly computer self-efficacy and perceived ease of use are related to performance using C2IPS during training. For computer self-efficacy, previous results from the self-efficacy literature seem to have been borne out by this study, especially with regard to increasing a person's confidence and mobilizing behavior to attain performance (Locke, et al., 1984; Wood and Bandura, 1989). Similarly, the hypothesized but never demonstrated perceived ease of use to performance link has been supported (Davis, 1989). In fact, the ability of perceived ease of use to predict performance from the beginning of training to the end of training actually increased. This increase could be explained through the increased effectiveness of thought processes, manipulations, and procedures required effectively use the information system as a result of simply progressing through the training course. For example, a procedure to enter information into a database that once may have seemed daunting or impossible before training may seem easy once taught to and practiced by the trainee.

When viewed from a post-training, on-the-job standpoint, the performance picture changes. As shown in Table 19, perceived usefulness and self-reported usage become significant predictors of on-the-job performance with computer self-efficacy significant only at time 1. In fact, the ability of perceived usefulness to predict performance improves over time. When connected with the definition of perceived usefulness, the behavior of perceived usefulness is more easily explained. According to Davis (1989), perceived usefulness is defined as the prospective user's subjective probability that using an information system will increase his job performance within an organizational context. Since the training for this study was conducted outside the trainee's normal work environment, it seems plausible that the "organizational context" component of perceived usefulness was rendered irrelevant. In addition, the focus of C2IPS training was to learn to use the system rather than to figure out how the system would contribute to job performance. Finally, in a typical work environment, job performance is the primary focus of daily activity. In this environment, the relevance of C2IPS in attaining the required performance is likely to be a much more germane issue for most Air Force members. In the job environment, perceived usefulness likely has more relevance as a measure of on-the-job performance. Using these explanations, it seems reasonable to assume that the link between perceived usefulness and on-the-job performance would be weak at the beginning of training when the trainee has just arrived in the training environment. At the end of training, perceived usefulness would be higher as the trainee begins to make the connection between what he/she has learned and how it may contribute to the job context. Finally, perceived usefulness would be highest on-the-job where the use of the system and job performance are more easily linked.

Self-reported usage was the "surprise" variable of this study. Hypotheses regarding self-reported usage were not made for this study, but its efficacy in predicting performance across all stages of the training continuum deserves some discussion. Intuitively, it seems that the more a person uses an information system, the better he or she should perform. Therefore, a relationship between usage and performance is entirely feasible. Indeed, the results presented in Chapter IV bear this out. Use of a system may be described as a necessary but not sufficient component of performance along with other components such as level and duration. Despite the promise of this explanation, the relationship is anything but conclusive due to the design of this study. For instance, self-reported usage was measured only once at the beginning of the training courses using one item. The item asked how much time the trainee spent on C2IPS in a given day. Repeated measures and more items that capture self-reported usage may increase the validity of the measure somewhat. Better yet, actual measures of usage would provide even more credibility. Nonetheless, if one conceives of self-reported usage as an "exploratory" variable, then the consistent results it produced certainly merits more in-depth investigation as to the strength and nature of the usage to performance relationship.

Computer attitude was not significant in predicting performance at any time. The most likely explanation is that computer attitude as measured is "broad band" and perhaps captured attitudes about computers in general rather than those associated strictly with C2IPS. In this sense, the computer attitude measure may not have been focused enough to capture a relationship with performance. In addition, in several cases computer attitude was nearly significant suggesting that larger numbers of participants may have yielded a significant result. Whether a larger sample size correlates to

measuring a "broad band" relationship of computer attitude to performance is debatable. At best, supervisors and training instructors should be cautioned in their use of computer attitude as a predictor of performance and utility of C2IPS.

Based on the results and observations presented above, a revised information technology training model can be formulated. This model is shown in Figure 8.

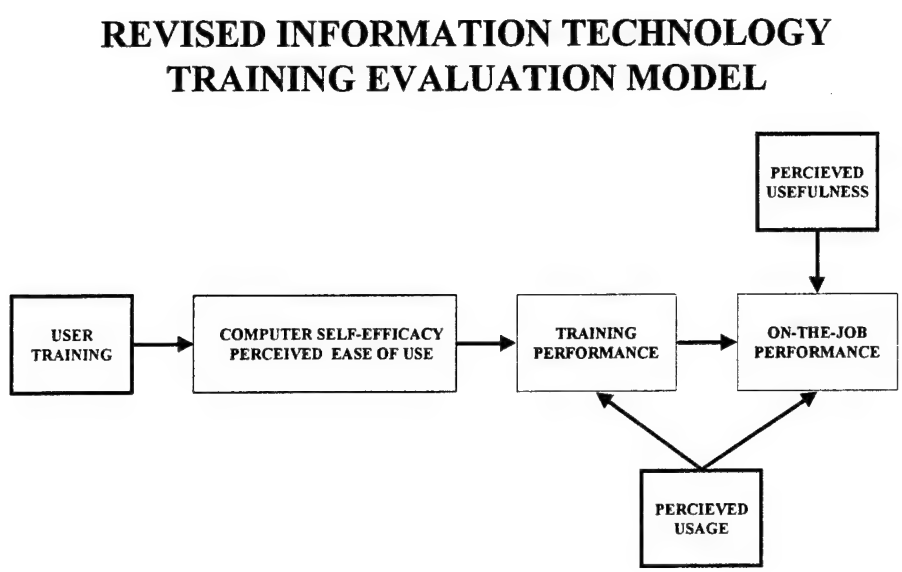


Figure 8. Revised Information Technology Training Model

The fact that some variables influence performance can be of practical use to training instructors. Knowing which variables predict performance enables instructors to develop and improve methods to increase performance that target the desired variable. In this way, the training course can be focused to on the variables that will maximize training performance. In addition, instructors, supervisors, and resource providers can use these variables as surrogates of performance when measurement of performance is impractical or difficult.

Perhaps the most significant use of predictor variables is in the area of information technology training development. The development of a new information system entails many uncertainties including the ability of a user to perform job task using the system. In addition, the ability of the system itself to facilitate performance of specified tasks may be uncertain. By measuring a user's computer self-efficacy, perceived usefulness, and perceived ease of use, a reasonable indication of the user's ability to perform may be produced. Low measures may indicate deficiencies in training methods or performance criteria. These measures in turn can provide feedback to developers for improving both the information system and the training on the system before investing capital toward future development.

Additional Observations

The fact that the means for on-the-job self-rated performance and supervisor-rated performance were exactly the same was unexpected. Given the literature on the subject, self-rated performance was expected to be significantly higher than supervisor-rated performance. One possible explanation for this is that the training may have taken place recently enough for both supervisor and subordinate to make sufficiently unbiased estimates of C2IPS performance. Additionally, the performance instrument itself may have been narrow enough to eliminate any inflationary bias. Despite the positive impact of this observation on this study, however, the small number of cases analyzed (N=22) makes it unclear whether the results can be generalized to a larger population.

From a practical standpoint, however, supervisors, instructors, and training resource providers may view self-rated performance measures as "suitable" substitutes for more "objective" supervisor ratings.

Limitations of Study

Several factors limit the generalizability of this study including the research design, sample population, sample size, performance measure used, and the limited focus of this study centering on learning and performance. No study can be perfect, and improvements or changes in these areas may lead to different results and conclusions.

The research design for this study used a variation of the quasi-experimental time series design. In a time series design, several measures are taken before and after an event and allows subjects to be their own controls (Cooper and Emery, 1995). However, the main internal validity problem for this design is history. History, in the case of this study, is the chance that events could have occurred that confused the relationship of performance and learning to the reaction variables. Since each training class was conducted at different times and places without the presence of trained researchers, such events could likely have occurred. In addition, maturation and testing effects could have had an influence on the participants. Testing effects are a particular concern as all variables were measured a total of 3 different times using exactly the same items and scales. An alternative approach may be to develop several items for each measure and construct multiple surveys and randomize items to reduce such effects. In addition, self-reported usage was measured only once at the beginning of training and supervisor-rated performance was measured only once on-the-job. Additional measures of these variables would provide a basis of comparison and eliminate some internal validity concerns. It is hoped that the measurement of multiple training classes may have diluted these effects somewhat, but the reality is that the data collected for this study may have been adversely impacted in unpredictable ways.

External validity is also limited in this study by virtue of the fact that a convenience sample representing a narrow part of the Air Force population was used. The results may be extremely valid for Air Force C2IPS personnel, but may not be applicable for other groups who undergo information technology training, for example, in a commercial software firm. Repeated application of the hypothesis procedures used in this study on other sample populations will enhance the general validity of this study's results.

A larger sample size for each training course would not only increase the overall statistical power of the study, but also would allow comparisons between training courses and better detection of the similarities and differences between them. For example, potential analysis of C2IPS demographic effects was largely precluded due to the relatively small sample sizes associated with each training course.

The performance measure used for analyzing data was subjective. Even though a case was made for the use of self-reports in Chapter II, an objective performance measure would likely be more credible for both the researcher and the practitioner. Even so, the scope, duration, and window of opportunity of this study precluded the collection of such a measure.

The last major limitation concerns the variance explained in the relationship between reactions and learning/performance. Clearly, the models do not explain all that accounts for increases in performance and learning. Even more clearly, many more aspects of training can influence learning and performance such as the training instructor, training environment, training method, training quality, personal factors, supervisor support, and work environment. Some or all of these factors may contribute significantly

to increasing learning and performance as the result of information technology training. Thus, additional research could focus on extending this study to include other variables.

Conclusions and Recommendations

Despite limitations of this study, several reasonable conclusions can be offered with regard to C2IPS training.

- Information technology training increases computer self-efficacy, perceived ease of use, learning, and performance.
- These increases are transferred to the work environment resulting in a more confident and proficient user of C2IPS.
- Computer self-efficacy, perceived ease of use, perceived usefulness, and self-reported usage are significant predictors of training performance on C2IPS.
- Computer attitude does not predict performance at any time.

From a practical standpoint, supervisors can use computer self-efficacy and perceived ease of use as quick indicators of performance in lieu of objective measures of performance and to evaluate a trainee's readiness or need to attend training. If a person's computer self-efficacy and perceived ease of use is low, then performance may be low, indicating a need for training. Training instructors can use the measures to evaluate a trainee's disposition toward performance before starting training and their performance progress during training. Similarly, perceived usefulness can be used as an indicator of future performance after training or current performance on a particular information system and be used to explain how the information system actually contributes to job performance. Self-reported usage may be the "ace in the hole" for both trainer and supervisor. Because usage seems to impact performance both in training and on-the-job,

getting an individual working on a system is a definite way to begin increasing performance. Finally, information technology developers and training developers can use the predictor variables decribed in this study as indicators of whether or not a particular system or training program contributes to performance. Judicious use of these variable may reduce uncertainty in and improve future system and training development.

Overall, the C2IPS training program seems to be providing highly motivated, trained users who increase and sustain their performance on C2IPS upon return to their jobs. On-going collection of data similar to that presented in this study can ensure this success story continues. Because of the stability of the measures over time, administration of surveys both during training and on-the-job will yield valid data on computer self-efficacy, perceived ease of use, perceived usefulness, self-reported usage, and performance. This data will provide assurance to C2IPS instructors, training managers, and field supervisors that C2IPS training courses are meeting their goals. In addition, this data provides valuable information that developers and senior decision-makers need to continue to improve and fund the C2IPS training program.

Implications for Future Research

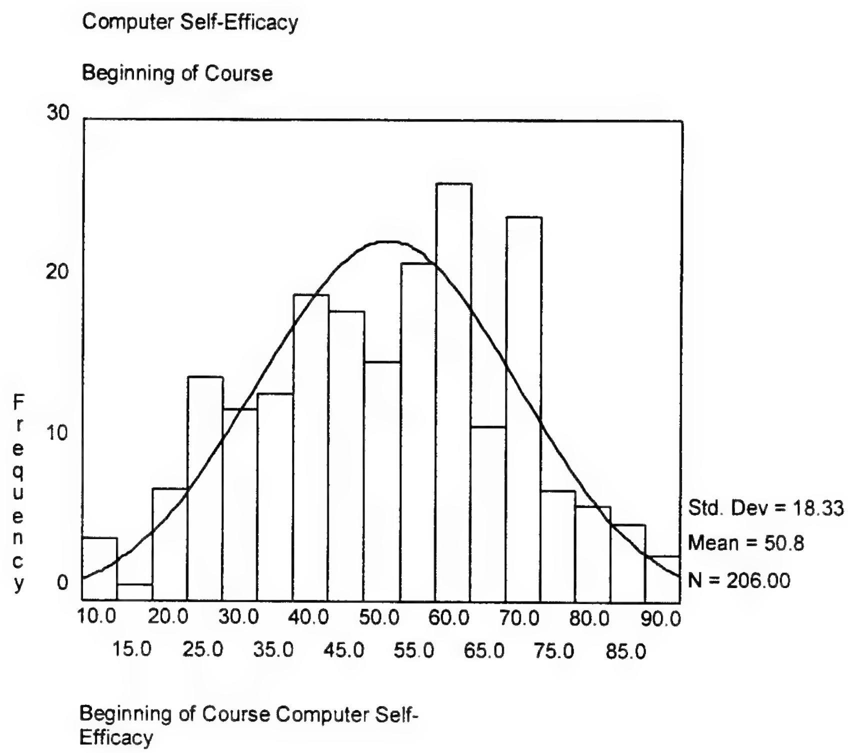
Based on this study, several interesting avenues for future research exist. Generalizability of the reaction to performance relationships described above would be increased if other groups and training courses were measured. The study of the information technology usage to performance relationship using either subjective or objective measures would shed light on the exact nature of the influence of usage on performance and what other factors may contribute to performance. The inelasticity of perceived usefulness and computer attitude to training interventions could help explain

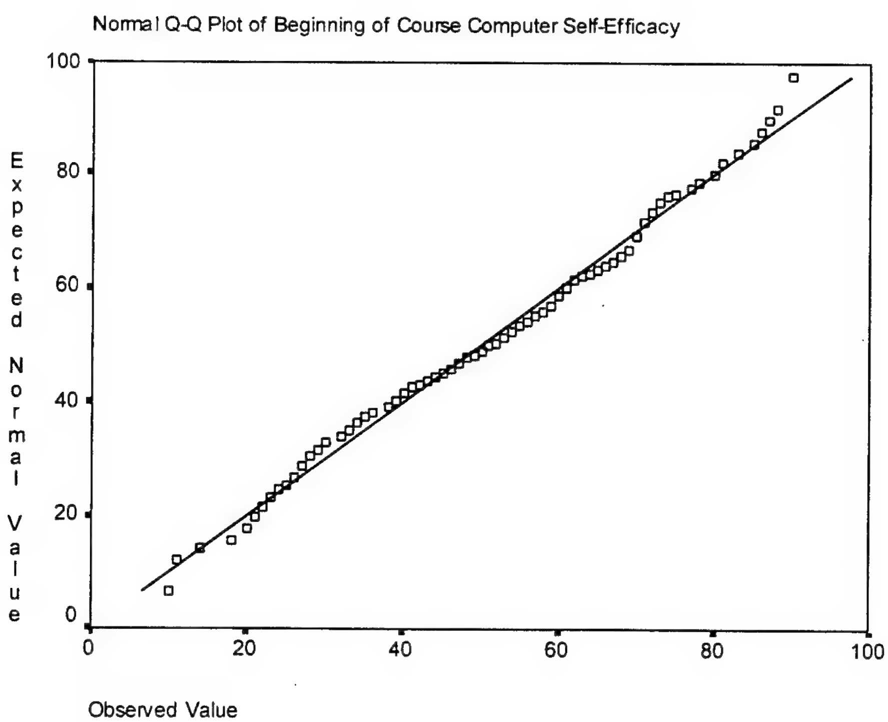
how these perceptions are formed and how they might be changed in a more lasting way, especially when the relationship of perceived usefulness to performance is taken into account. Next, more study is warranted regarding the influence of reactions on learning. The literature supports this link, but the link was not supported by this study. Also useful would be an investigation as to the influence of the work environment on performance using information technology. Finally, a comparison of formal information technology training like that used for this study against other training methods such as on-the-job training could help show if one method is better than the other using differences in variable predictability as gauges.

Summary

Information technology training is crucial for providing personnel the requisite skills needed to perform effectively if the Air Force is to remain competitive in today's automated warfighting environment. Information technology training programs that continuously provide these skilled personnel will be the ones that are embraced, supported, and sustained by the Air Force despite dwindling resources to allocate toward these efforts. This study explored one such training program in an attempt to capture key elements that influence information technology performance both during training and on-the-job. An understanding of the magnitude, relationships, and nature of these elements will help training instructors design and deliver higher quality training, enable supervisors to identify people for training and gauge their performance after training, and enable decision makers to allocate scarce resources to information technology training programs that produce results. For the Air Force, effective information technology training programs are essential achieving "Information Dominance" and "Global Reach".

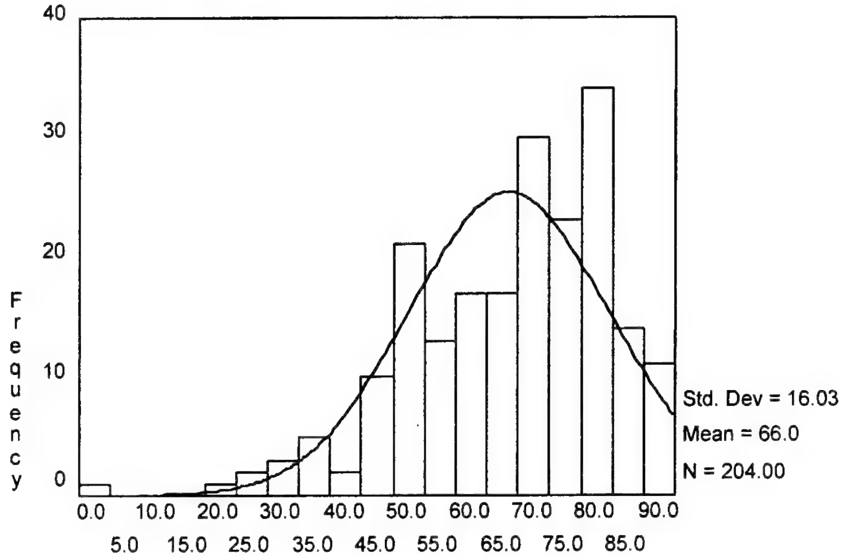
Appendix A: Variable Histograms and Q-Q Plots





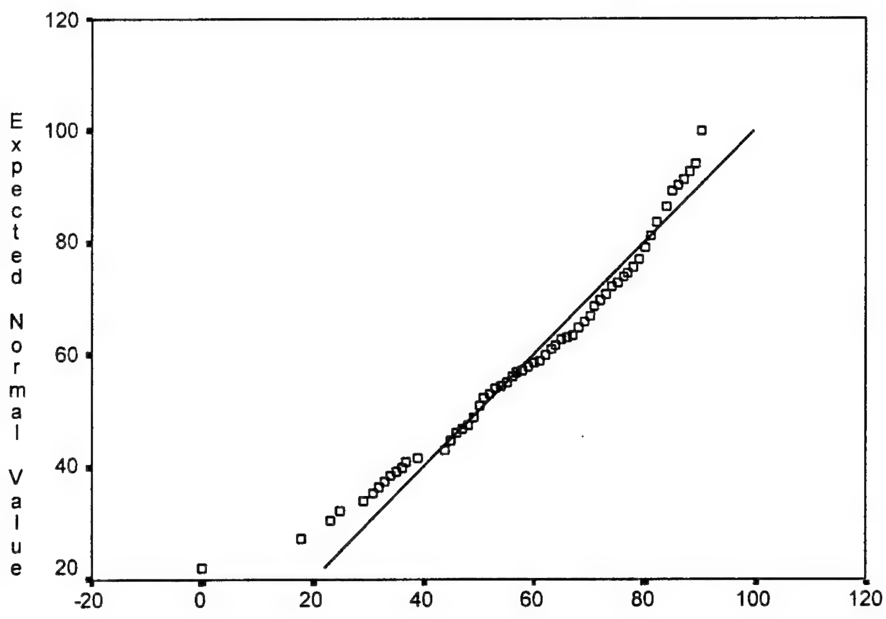
Computer Self-Efficacy

End of Course



End of Course Computer Self-Efficacy

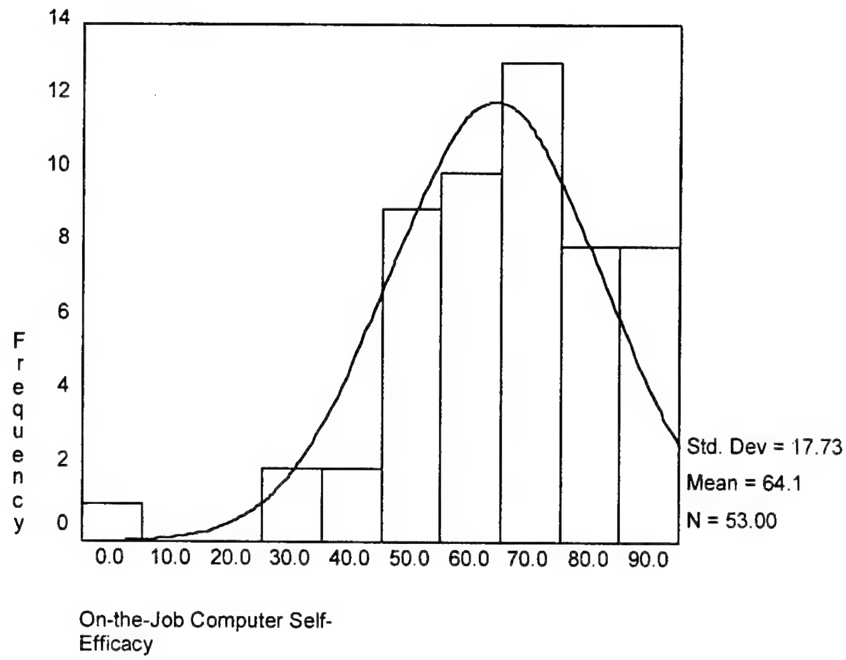
Normal Q-Q Plot of End of Course Computer Self-Efficacy



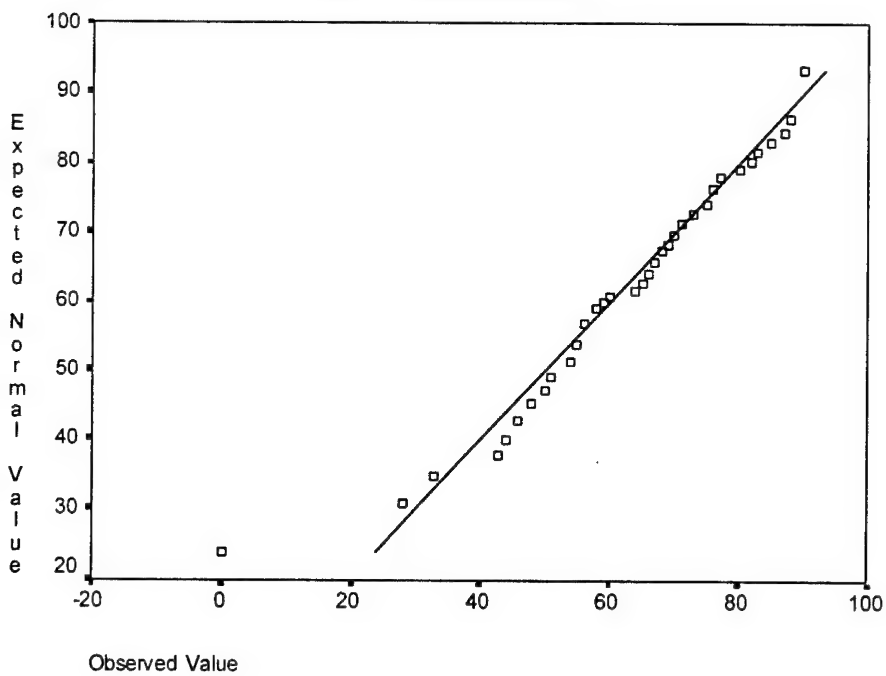
Observed Value

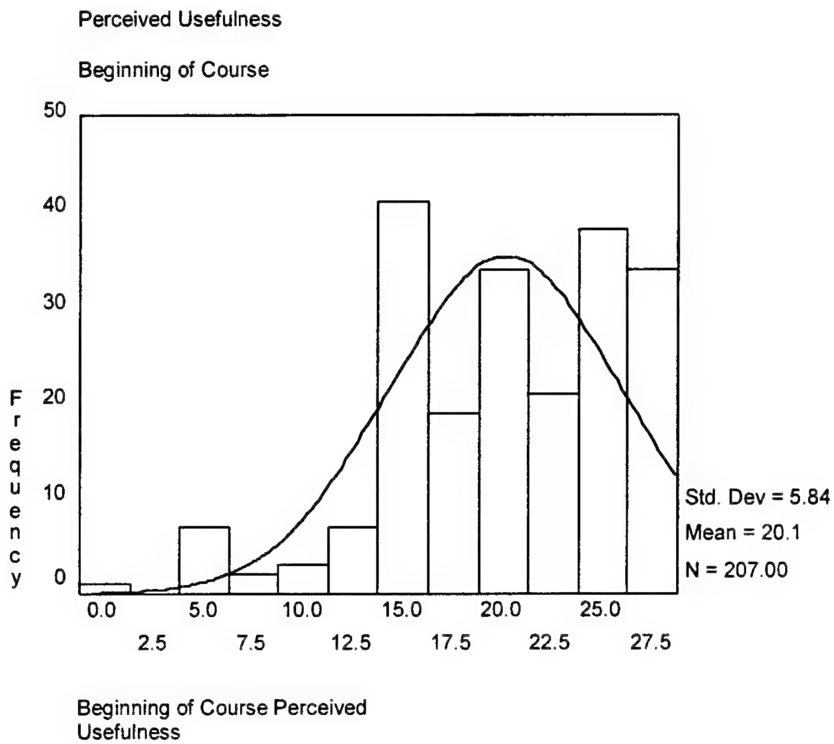
Computer Self-Efficacy

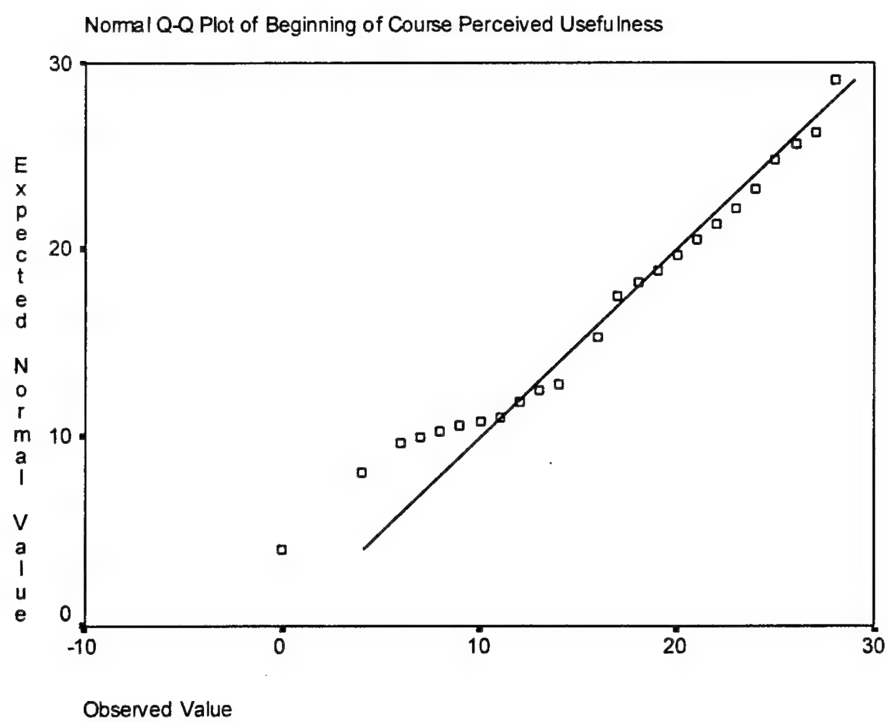
On-the-Job



Normal Q-Q Plot of On-the-Job Computer Self-Efficacy

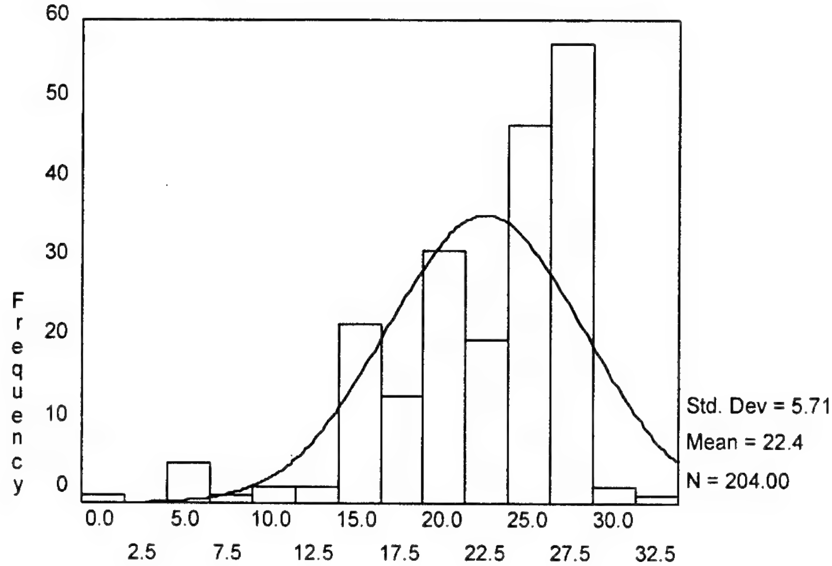



Perceived Usefulness
Beginning of Course
50
40
30
20
10
0
Frequency
Std. Dev = 5.84
Mean = 20.1
N = 207.00
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
Beginning of Course Perceived Usefulness


Normal Q-Q Plot of Beginning of Course Perceived Usefulness
30
20
10
0
Expected Normal Value
-10
0
10
20
30
Observed Value

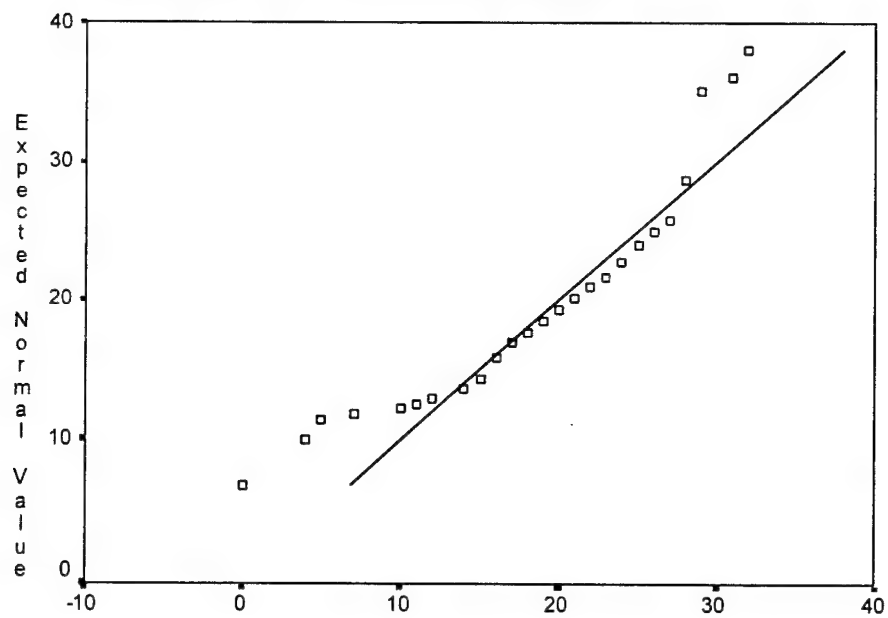
Perceived Usefulness

End of Course

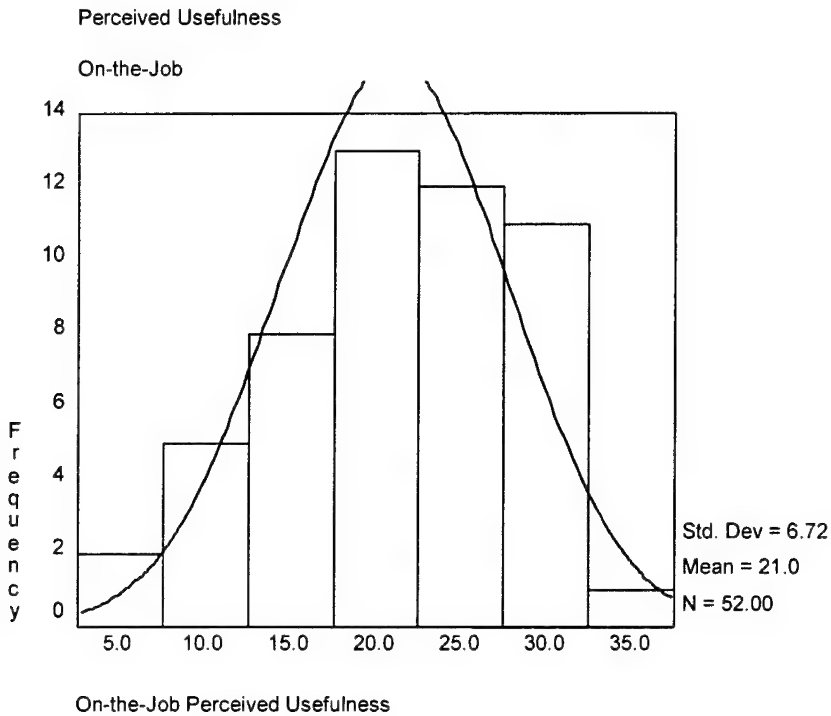


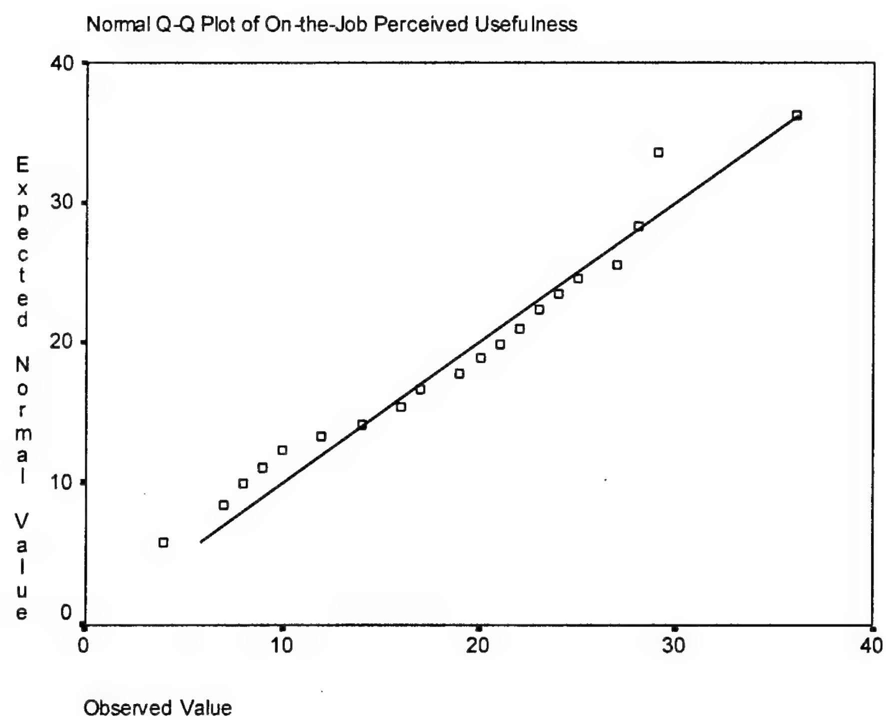
End of Course Perceived Usefulness

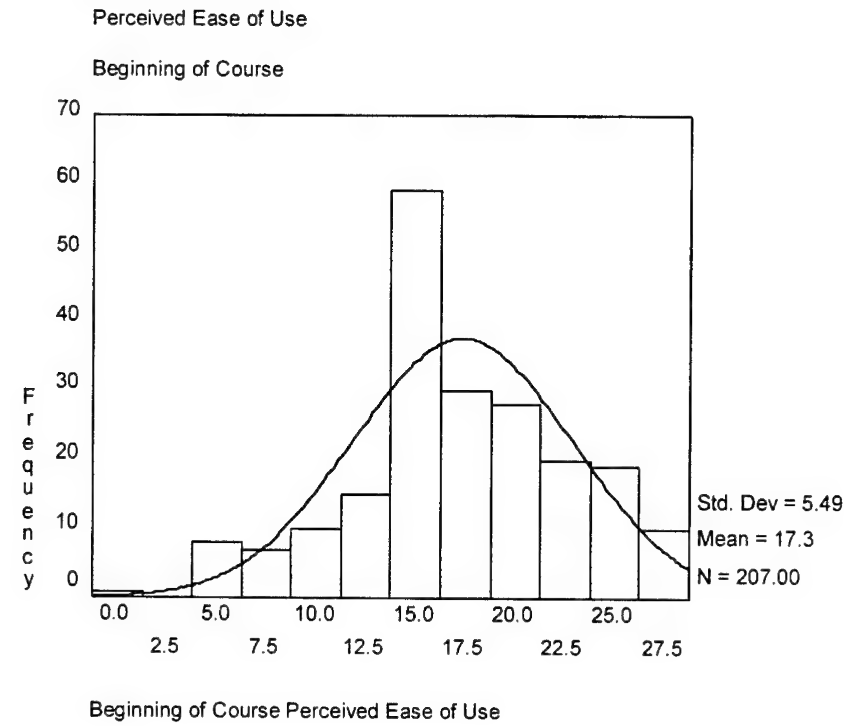
Normal Q-Q Plot of End of Course Perceived Usefulness

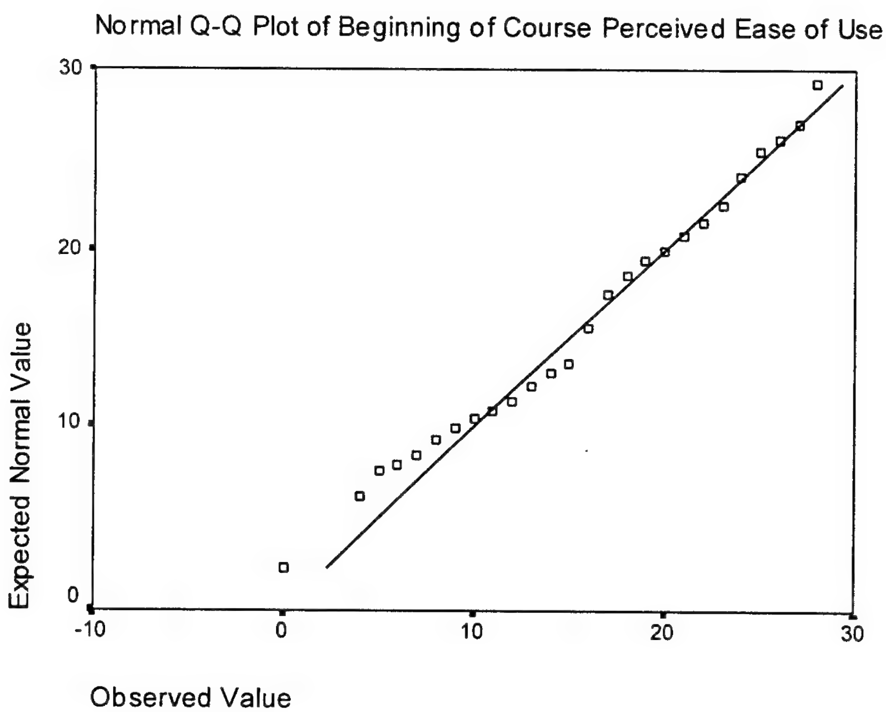


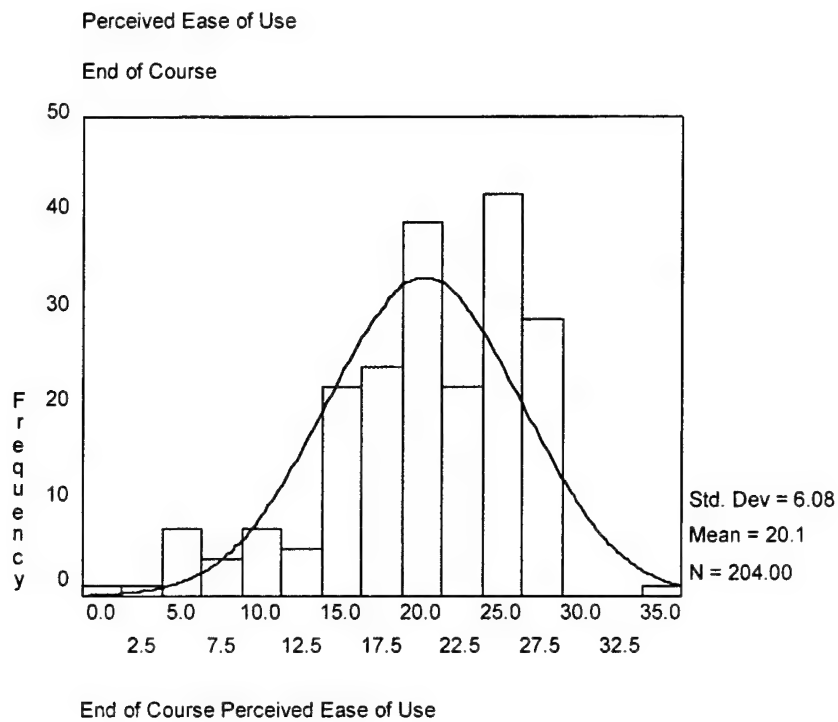
Observed Value


Perceived Usefulness
On-the-Job
14
12
10
8
6
4
2
0
Frequency
Std. Dev = 6.72
Mean = 21.0
N = 52.00
5.0
10.0
15.0
20.0
25.0
30.0
35.0
On-the-Job Perceived Usefulness

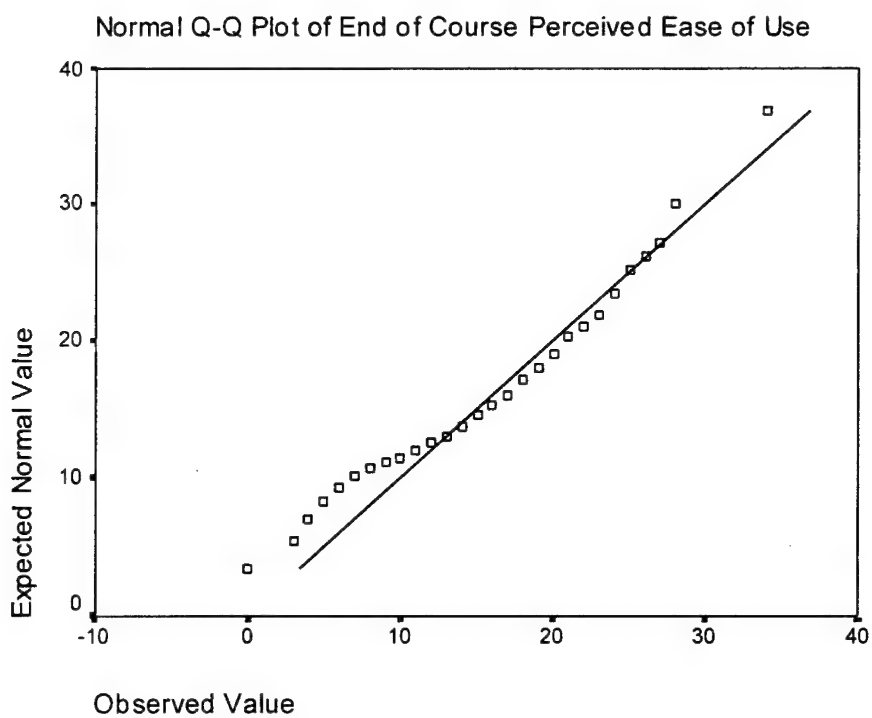

Normal Q-Q Plot of On-the-Job Perceived Usefulness
40
30
20
10
0
Expected Normal Value
0
10
20
30
40
Observed Value


Perceived Ease of Use
Beginning of Course
Frequency
70
60
50
40
30
20
10
0
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
Std. Dev = 5.49
Mean = 17.3
N = 207.00
Beginning of Course Perceived Ease of Use

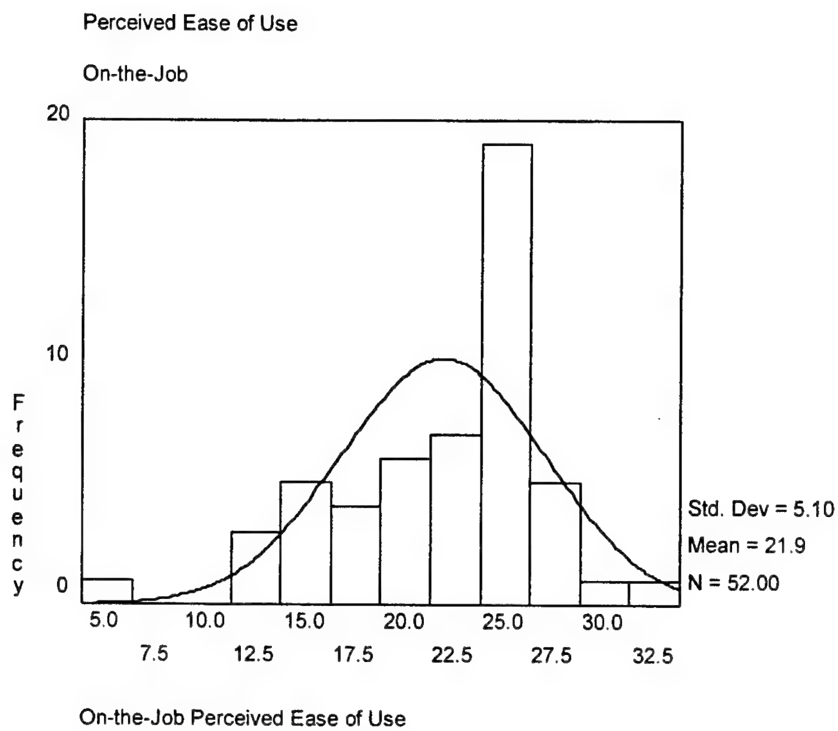

Normal Q-Q Plot of Beginning of Course Perceived Ease of Use
Expected Normal Value
30
20
10
0
-10
0
10
20
30
Observed Value



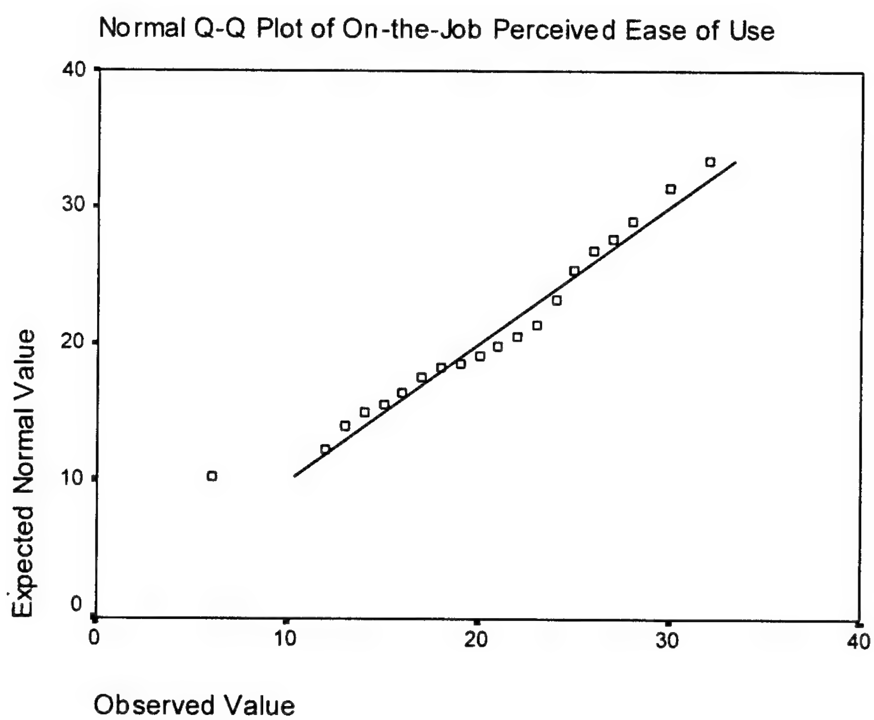
Perceived Ease of Use
End of Course
Frequency
50
40
30
20
10
0
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0
2.5 7.5 12.5 17.5 22.5 27.5 32.5
Std. Dev = 6.08
Mean = 20.1
N = 204.00
End of Course Perceived Ease of Use



Normal Q-Q Plot of End of Course Perceived Ease of Use
40
30
20
10
0
Expected Normal Value
-10 0 10 20 30 40
Observed Value



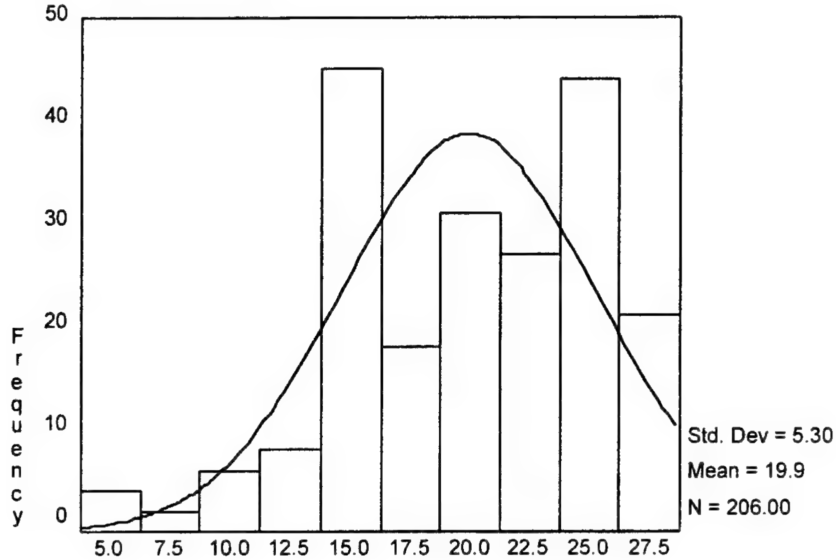
Perceived Ease of Use
On-the-Job
20
10
0
Frequency
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
30.0
32.5
Std. Dev = 5.10
Mean = 21.9
N = 52.00
On-the-Job Perceived Ease of Use



Normal Q-Q Plot of On-the-Job Perceived Ease of Use
40
30
20
10
0
Expected Normal Value
0
10
20
30
40
Observed Value

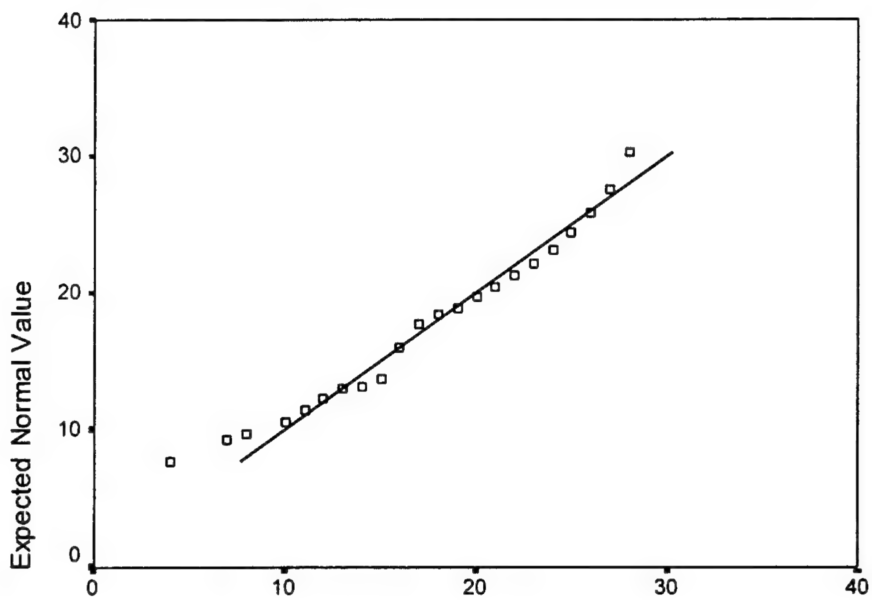
Computer Attitude

Beginning of Course

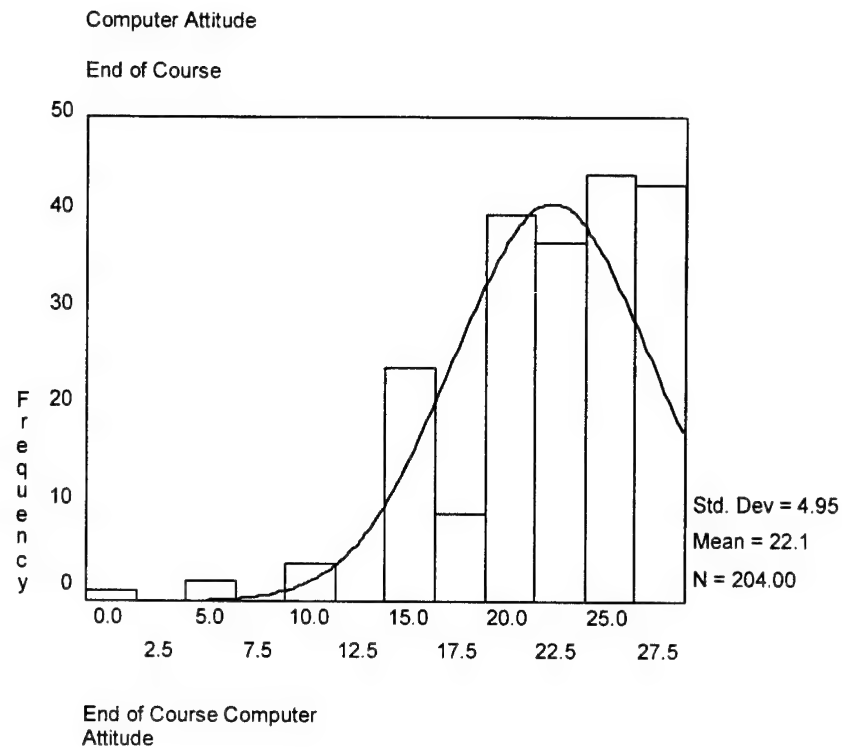


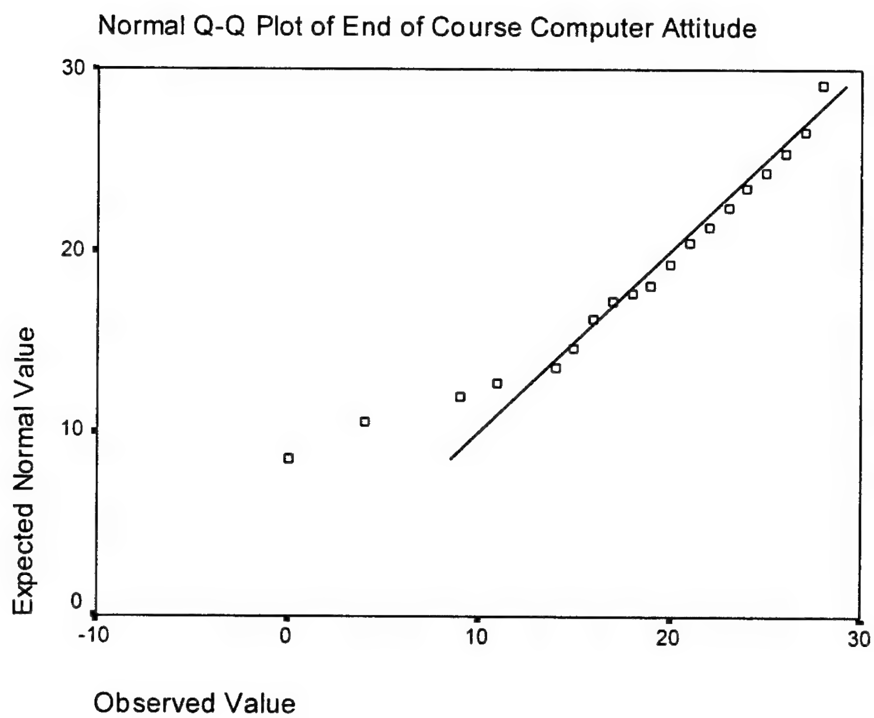
Beginning of Course Computer Attitude

Normal Q-Q Plot of Beginning of Course Computer Attitude



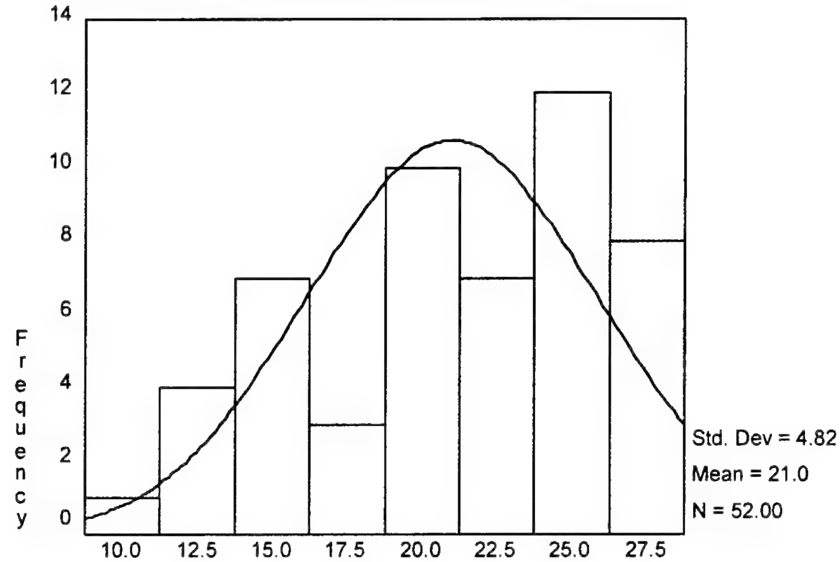
Observed Value


Computer Attitude
End of Course
50
40
30
20
10
0
Frequency
Std. Dev = 4.95
Mean = 22.1
N = 204.00
0.0
5.0
10.0
15.0
20.0
25.0
2.5
7.5
12.5
17.5
22.5
27.5
End of Course Computer Attitude


Normal Q-Q Plot of End of Course Computer Attitude
30
20
10
0
Expected Normal Value
-10
0
10
20
30
Observed Value

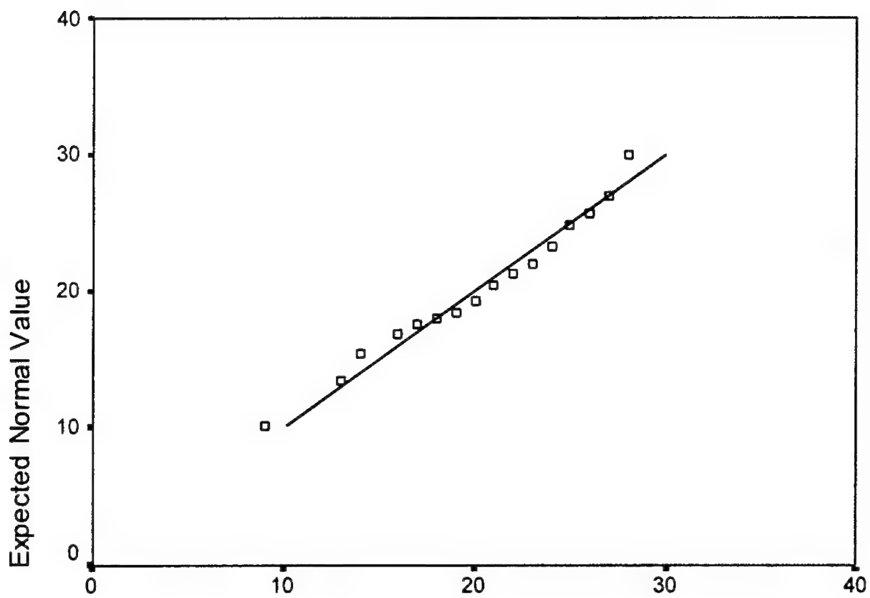
Computer Attitude

On-the-Job

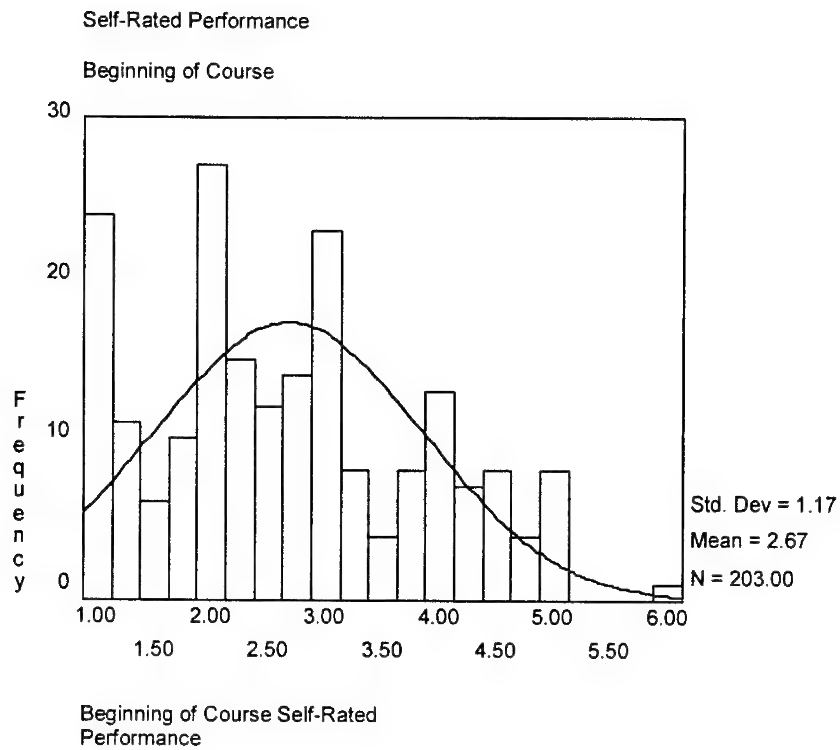


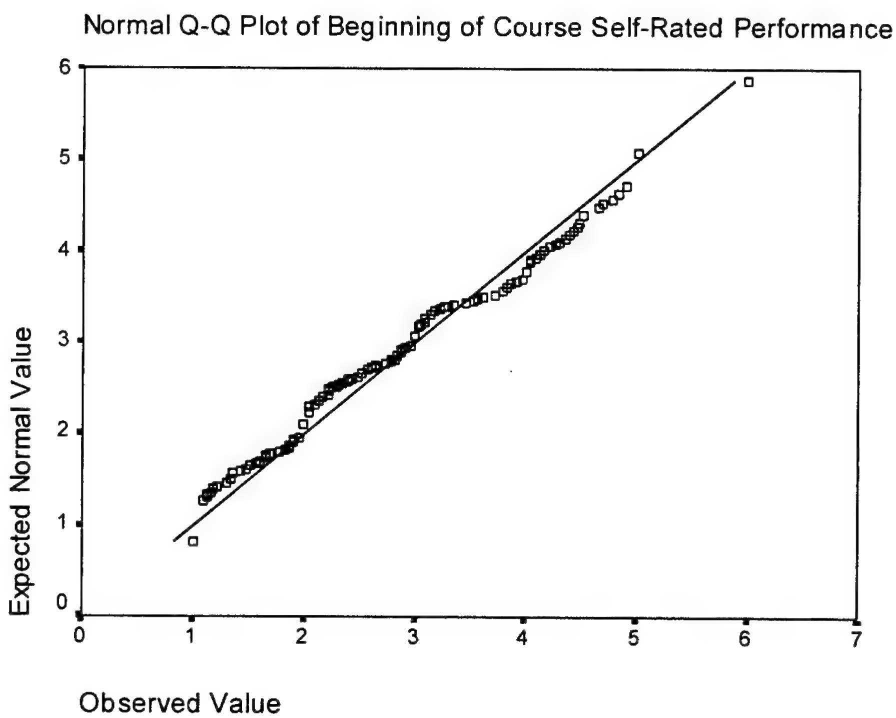
On-the-Job Computer Attitude

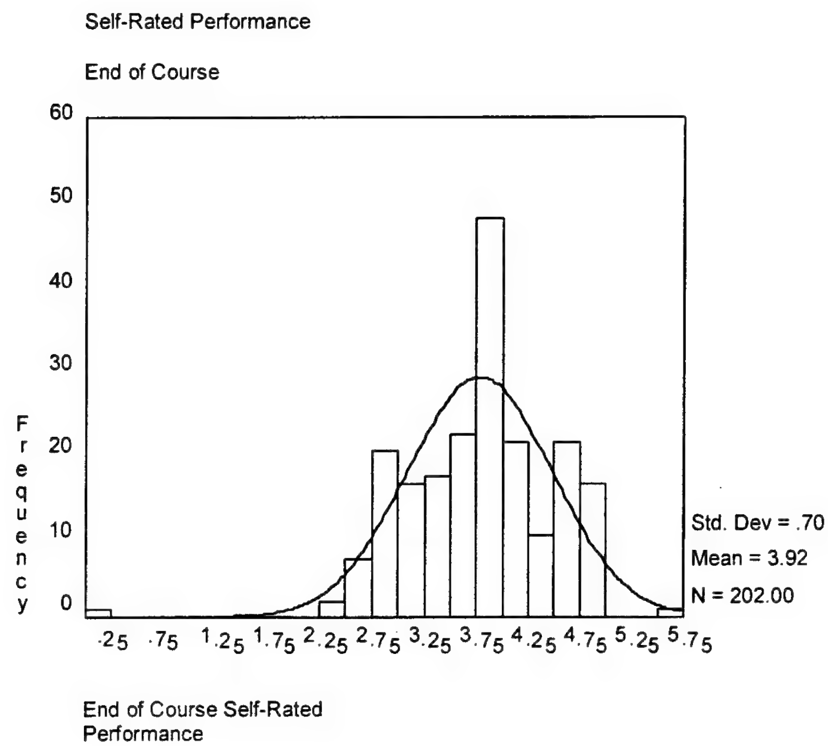
Normal Q-Q Plot of On-the-Job Computer Attitude

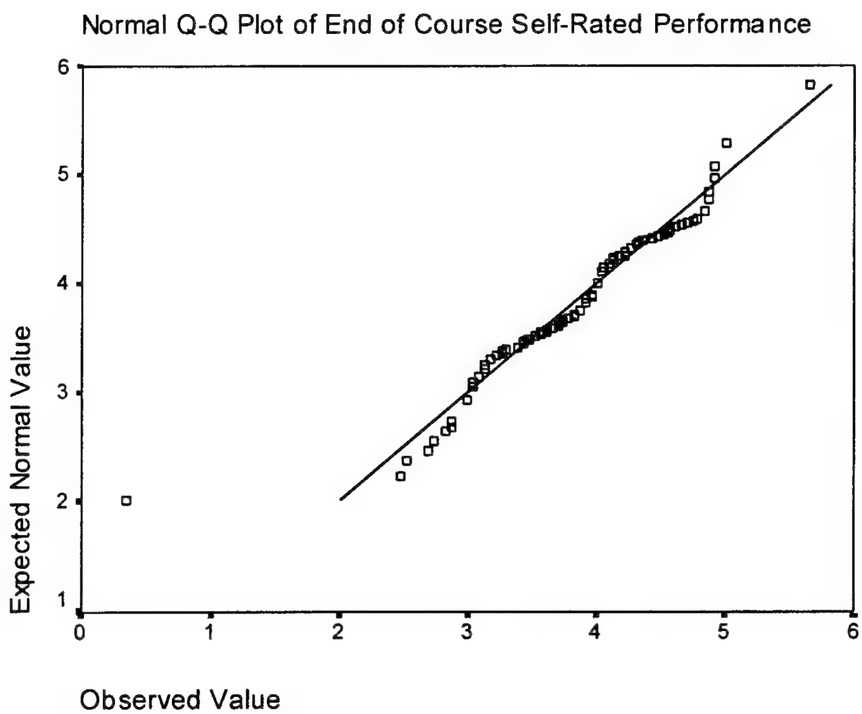


Observed Value


Self-Rated Performance
Beginning of Course
Frequency
30
20
10
0
Std. Dev = 1.17
Mean = 2.67
N = 203.00
1.00
2.00
3.00
4.00
5.00
6.00
1.50
2.50
3.50
4.50
5.50
Beginning of Course Self-Rated Performance

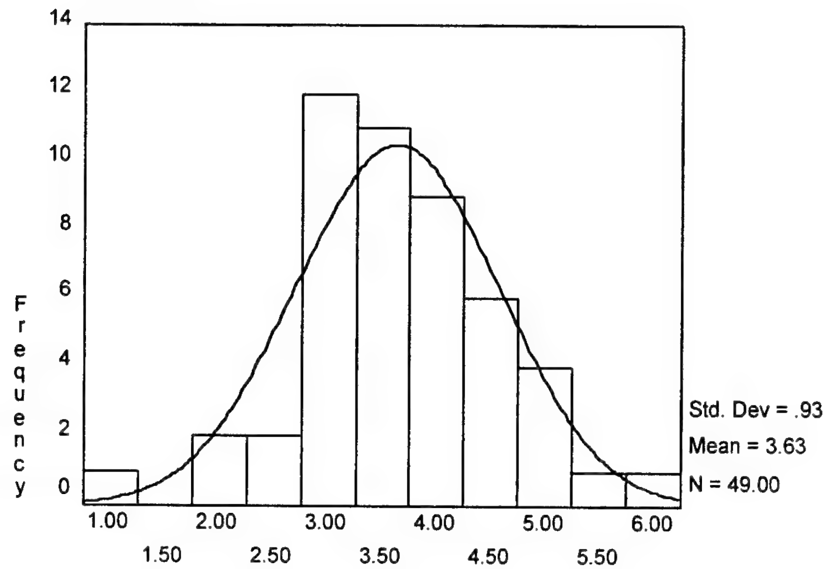

Normal Q-Q Plot of Beginning of Course Self-Rated Performance
Expected Normal Value
Observed Value
0
1
2
3
4
5
6
7


Self-Rated Performance
End of Course
60
50
40
30
20
10
0
Frequency
Std. Dev = .70
Mean = 3.92
N = 202.00
.25
.75
1.25
1.75
2.25
2.75
3.25
3.75
4.25
4.75
5.25
5.75
End of Course Self-Rated Performance


Normal Q-Q Plot of End of Course Self-Rated Performance
Expected Normal Value
6
5
4
3
2
1
0
1
2
3
4
5
6
Observed Value

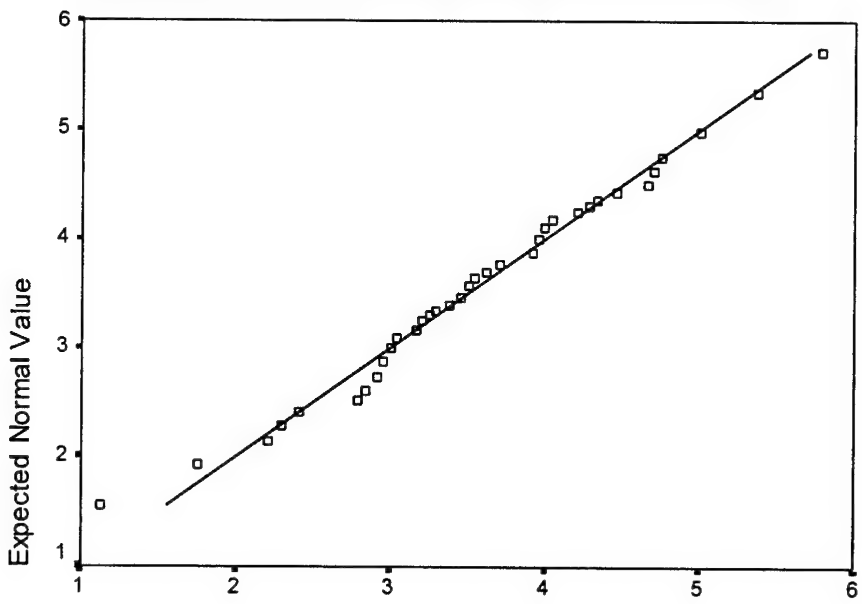
Self-Rated Performance

On-the-Job

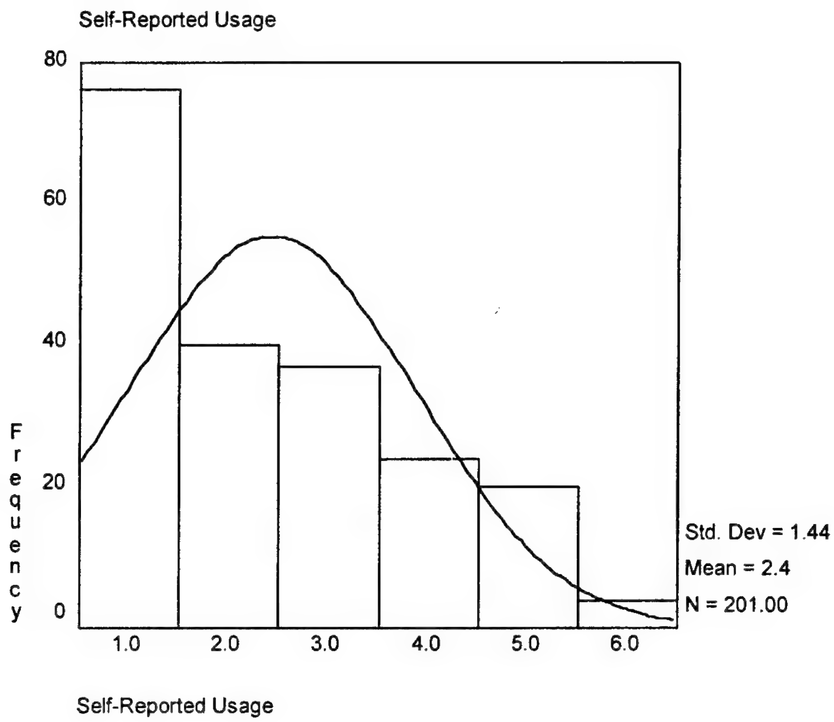


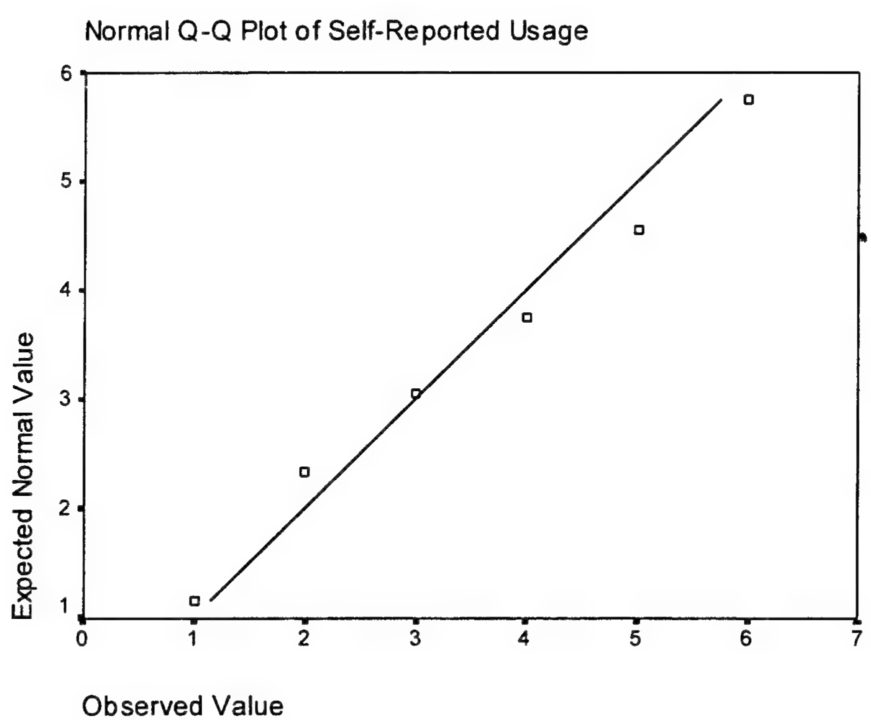
On-the-Job Self-Rated Performance

Normal Q-Q Plot of On-the-Job Self-Rated Performance



Observed Value


Self-Reported Usage
80
60
40
20
0
Frequency
1.0
2.0
3.0
4.0
5.0
6.0
Std. Dev = 1.44
Mean = 2.4
N = 201.00
Self-Reported Usage


Normal Q-Q Plot of Self-Reported Usage
6
5
4
3
2
1
Expected Normal Value
0
1
2
3
4
5
6
7
Observed Value

Appendix B: Overall Factor Analysis for Scale Variables

COMMUNALITIES USING VARIMAX ROTATION, TIME 1 AND TIME 2

Item	Communalities, Time 1	Communalities, Time 2
Computer Self-Efficacy Item 1	1	1
Computer Self-Efficacy Item 2	1	1
Computer Self-Efficacy Item 3	1	1
Computer Self-Efficacy Item 4	1	1
Computer Self-Efficacy Item 5	1	1
Computer Self-Efficacy Item 6	1	1
Computer Self-Efficacy Item 7	1	1
Computer Self-Efficacy Item 8	1	1
Computer Self-Efficacy Item 9	1	1
Computer Self-Efficacy Item 10	1	1
Perceived Usefulness Item 1	1	1
Perceived Usefulness Item 2	1	1
Perceived Usefulness Item 3	1	1
Perceived Usefulness Item 4	1	1
Perceived Ease Of Use Item 1	1	1
Perceived Ease Of Use Item 2	1	1
Perceived Ease Of Use Item 3	1	1
Perceived Ease Of Use Item 4	1	1
Computer Attitude Item 1	1	1
Computer Attitude Item 2	1	1
Computer Attitude Item 3	1	1
Computer Attitude Item 4	1	1
Self-Rated Performance Item 1	1	1
Self-Rated Performance Item 2	1	1
Self-Rated Performance Item 3	1	1
Self-Rated Performance Item 4	1	1
Self-Rated Performance Item 5	1	1
Self-Rated Performance Item 6	1	1
Self-Rated Performance Item 7	1	1
Self-Rated Performance Item 8	1	1
Self-Rated Performance Item 9	1	1
Self-Rated Performance Item 10	1	1
Self-Rated Performance Item 11	1	1
Self-Rated Performance Item 12	1	1
Self-Rated Performance Item 13	1	1
Self-Rated Performance Item 14	1	1
Self-Rated Performance Item 15	1	1
Self-Rated Performance Item 16	1	1
Self-Rated Performance Item 17	1	1
Self-Rated Performance Item 18	1	1
Self-Rated Performance Item 19	1	1
Self-Rated Performance Item 20	1	1
Self-Rated Performance Item 21	1	1
Self-Rated Performance Item 22	1	1
Self-Rated Performance Item 23	1	1

OVERALL FACTOR ANALYSIS ROTATED COMPONENT MATRIX, TIME 1

Component 1	Component 2	Component 3	Component 4	Component 5	Component 6
0.34	0.49	0.02	0.12	0.28	0.53
0.16	0.65	-0.04	0.00	0.20	0.04
0.28	0.68	0.08	0.07	0.20	-0.04
0.28	0.80	-0.06	-0.02	0.18	-0.04
0.26	0.83	0.04	0.09	0.05	0.08
0.26	0.87	0.05	0.08	0.03	0.09
0.18	0.86	0.08	0.04	0.03	0.12
0.29	0.76	0.14	0.01	0.13	0.13
0.21	0.83	0.12	0.13	-0.09	0.05
0.10	0.75	0.14	0.12	0.13	0.06
0.04	0.12	0.25	0.82	0.17	0.10
0.16	0.10	0.22	0.88	0.12	-0.04
0.17	0.10	0.36	0.80	0.20	0.01
0.21	0.07	0.47	0.71	0.17	0.11
0.23	0.28	0.05	0.28	0.50	0.38
0.18	0.16	0.11	0.17	0.76	0.04
0.25	0.25	0.27	0.24	0.76	0.08
0.19	0.19	0.41	0.12	0.72	0.07
0.15	0.11	0.84	0.37	0.09	0.02
0.16	0.11	0.86	0.30	0.09	0.04
0.12	0.05	0.83	0.28	0.23	0.06
0.10	0.10	0.65	0.19	0.49	0.02
0.70	0.24	0.09	0.11	0.19	0.42
0.78	0.16	0.17	0.04	0.12	0.42
0.70	0.18	0.20	0.02	0.23	0.52
0.73	0.22	0.20	0.03	0.19	0.47
0.77	0.24	0.10	0.09	0.10	0.48
0.81	0.20	-0.01	0.11	0.04	0.31
0.82	0.26	0.10	0.08	0.08	0.29
0.85	0.14	0.11	0.06	0.15	-0.19
0.90	0.18	0.11	0.01	0.10	0.05
0.91	0.16	0.08	0.04	0.13	-0.02
0.91	0.17	0.07	0.08	0.15	-0.04
0.91	0.18	0.09	0.06	0.14	0.01
0.88	0.10	0.13	0.07	0.15	-0.18
0.89	0.19	-0.01	0.07	0.04	0.18
0.88	0.16	-0.04	0.12	0.04	0.08
0.80	0.23	0.13	0.07	0.20	-0.01
0.87	0.19	0.11	0.05	0.08	0.15
0.82	0.27	0.12	0.00	0.14	-0.05
0.89	0.19	-0.03	0.11	0.07	-0.08
0.71	0.24	0.17	0.09	0.16	0.11
0.86	0.22	0.09	0.12	0.02	0.08
0.84	0.22	0.04	0.16	-0.02	0.08
0.80	0.25	0.07	0.16	-0.03	0.28

OVERALL FACTOR ANALYSIS ROTATED COMPONENT MATRIX, TIME 2

Component 1	Component 2	Component 3	Component 4	Component 5	Component 6	Component 7
0.23	0.53	0.20	0.26	0.16	0.06	-0.03
0.07	0.69	0.00	0.10	0.16	0.05	0.31
0.07	0.72	0.01	0.11	0.13	0.02	0.29
0.11	0.77	0.09	0.09	0.08	-0.03	0.13
0.11	0.87	0.07	0.08	0.08	0.03	-0.01
0.12	0.89	0.11	0.06	0.04	0.03	-0.07
0.08	0.86	0.17	0.04	0.03	-0.02	-0.02
0.19	0.74	0.17	0.00	0.12	-0.02	0.17
0.11	0.80	0.09	0.18	0.04	0.00	-0.13
0.17	0.79	0.20	0.06	0.04	0.00	-0.14
0.09	0.19	0.27	0.06	0.86	-0.04	0.03
0.16	0.15	0.27	0.07	0.84	-0.06	0.06
0.07	0.15	0.26	0.09	0.87	-0.04	0.03
0.15	0.09	0.30	0.10	0.85	-0.05	0.05
0.21	0.18	0.53	0.22	0.45	-0.08	0.11
0.12	0.19	0.47	0.06	0.07	-0.18	0.58
0.21	0.18	0.78	0.16	0.06	-0.04	0.28
0.26	0.10	0.73	0.12	0.22	-0.02	0.06
0.06	0.21	0.71	0.10	0.37	0.19	-0.22
0.08	0.14	0.77	0.11	0.37	0.16	-0.20
0.06	0.18	0.75	0.11	0.28	0.12	-0.02
0.17	0.13	0.71	0.12	0.15	0.07	0.19
0.28	0.12	0.14	0.73	0.09	0.10	-0.02
0.49	0.16	0.13	0.74	0.10	0.05	0.10
0.43	0.21	0.16	0.77	0.07	0.04	0.07
0.48	0.22	0.20	0.73	0.11	0.07	0.07
0.54	0.19	0.19	0.68	0.09	0.06	0.11
0.59	0.09	0.15	0.65	0.08	0.03	-0.07
0.63	0.11	0.14	0.50	0.15	0.10	0.21
0.80	0.10	0.05	0.07	0.09	-0.09	0.19
0.87	0.10	0.17	0.19	0.00	0.04	-0.06
0.89	0.05	0.17	0.18	-0.01	-0.01	-0.08
0.91	0.08	0.16	0.16	0.04	-0.05	-0.08
0.87	0.13	0.15	0.19	-0.01	-0.06	-0.06
0.81	0.16	0.11	-0.01	0.18	-0.04	0.14
0.70	0.12	0.19	0.44	0.02	0.07	-0.08
0.74	0.16	0.10	0.31	0.08	0.12	-0.17
0.61	0.15	0.21	0.41	0.03	0.15	0.32
0.71	0.08	0.09	0.31	0.17	0.19	0.23
0.67	0.17	0.04	0.22	0.13	0.10	0.37
0.82	0.18	0.05	0.18	0.09	0.12	0.04
0.47	0.23	0.06	0.35	0.15	0.09	0.44
0.75	0.14	-0.04	0.26	0.14	0.24	0.10
0.11	-0.01	0.08	0.07	-0.07	0.88	-0.05
0.12	0.04	0.12	0.14	-0.09	0.89	0.01

OVERALL FACTOR ANALYSIS TOTAL VARIANCE EXPLAINED, TIME 1 (CONVERGED IN 7 ITERATIONS)

	Initial Eigenvalues			Rotation of Sums of Squares Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1.00	22.17	49.26	49.26	16.80	37.33	37.33
2.00	5.39	11.98	61.24	7.02	15.59	52.92
3.00	4.12	9.15	70.39	3.63	8.08	61.00
4.00	1.62	3.61	74.00	3.34	7.42	68.41
5.00	1.32	2.93	76.93	2.93	6.51	74.93
6.00	1.12	2.50	79.42	2.02	4.49	79.42
7.00	0.85	1.89	81.31			
8.00	0.71	1.59	82.90			
9.00	0.57	1.27	84.17			
10.00	0.54	1.21	85.38			
11.00	0.51	1.14	86.52			
12.00	0.47	1.04	87.56			
13.00	0.45	1.01	88.56			
14.00	0.43	0.95	89.51			
15.00	0.40	0.88	90.40			
16.00	0.37	0.83	91.23			
17.00	0.33	0.73	91.96			
18.00	0.31	0.68	92.65			
19.00	0.29	0.63	93.28			
20.00	0.26	0.58	93.86			
21.00	0.23	0.50	94.36			
22.00	0.22	0.48	94.85			
23.00	0.21	0.48	95.32			
24.00	0.20	0.44	95.76			
25.00	0.18	0.40	96.16			
26.00	0.17	0.38	96.54			
27.00	0.17	0.37	96.92			
28.00	0.15	0.33	97.24			
29.00	0.13	0.29	97.54			
30.00	0.13	0.28	97.82			
31.00	0.12	0.26	98.08			
32.00	0.11	0.25	98.33			
33.00	0.11	0.25	98.58			
34.00	0.10	0.23	98.81			
35.00	0.09	0.21	99.01			
36.00	0.08	0.17	99.18			
37.00	0.07	0.16	99.33			
38.00	0.06	0.13	99.47			
39.00	0.06	0.12	99.59			
40.00	0.05	0.11	99.70			
41.00	0.05	0.10	99.80			
42.00	0.03	0.07	99.87			
43.00	0.02	0.06	99.93			
44.00	0.02	0.04	99.97			
45.00	0.01	0.03	100.00			

OVERALL FACTOR ANALYSIS TOTAL VARIANCE EXPLAINED, TIME 2 (CONVERGED IN 10 ITERATIONS)

	Initial Eigenvalues			Rotation of Sums of Squares Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1.00	17.74	39.43	39.43	10.48	23.29	23.29
2.00	5.74	12.76	52.19	6.77	15.05	38.34
3.00	3.99	8.87	61.06	4.72	10.49	48.83
4.00	2.18	4.84	65.90	4.66	10.35	59.18
5.00	1.62	3.60	69.50	3.91	8.68	67.87
6.00	1.49	3.31	72.80	1.93	4.30	72.16
7.00	1.23	2.74	75.55	1.52	3.39	75.55
8.00	0.96	2.14	77.69			
9.00	0.82	1.83	79.51			
10.00	0.80	1.79	81.30			
11.00	0.62	1.37	82.67			
12.00	0.59	1.31	83.99			
13.00	0.52	1.15	85.14			
14.00	0.50	1.12	86.25			
15.00	0.46	1.03	87.28			
16.00	0.44	0.98	88.27			
17.00	0.40	0.89	89.16			
18.00	0.40	0.88	90.04			
19.00	0.37	0.82	90.86			
20.00	0.34	0.76	91.62			
21.00	0.33	0.73	92.35			
22.00	0.30	0.68	93.03			
23.00	0.29	0.66	93.68			
24.00	0.26	0.57	94.25			
25.00	0.22	0.49	94.75			
26.00	0.21	0.46	95.21			
27.00	0.20	0.45	95.66			
28.00	0.19	0.41	96.07			
29.00	0.17	0.39	96.46			
30.00	0.17	0.37	96.83			
31.00	0.15	0.34	97.17			
32.00	0.15	0.34	97.51			
33.00	0.14	0.31	97.82			
34.00	0.13	0.29	98.11			
35.00	0.12	0.26	98.37			
36.00	0.11	0.23	98.60			
37.00	0.10	0.22	98.83			
38.00	0.10	0.22	99.05			
39.00	0.09	0.20	99.25			
40.00	0.09	0.19	99.44			
41.00	0.07	0.16	99.60			
42.00	0.06	0.13	99.73			
43.00	0.05	0.11	99.84			
44.00	0.04	0.09	99.93			
45.00	0.03	0.07	100.00			

Appendix C: Overall Pearson Correlations Between Selected Variables

	Computer Self-Efficacy, Time 1	Perceived Usefulness, Time 1	Perceived Ease of Use, Time 1	Computer Attitude, Time 1	Usage	Computer Self-Efficacy, Time 2	Perceived Usefulness, Time 2	Perceived Ease of Use, Time 2	Computer Attitude, Time 2	Beginning of Course Self-Rated Performance	End of Course Self-Rated Performance
Computer Self-Efficacy, Time 1	1.00	0.31**	0.46**	0.27**	0.20**	0.48**	0.21**	0 31**	0.25**	0.51**	0.42**
Perceived Usefulness, Time 1		1.00	0.54**	0.68**	0.21**	0.16**	0.54**	0.26**	0.40**	0.30**	0.20**
Perceived Ease of Use, Time 1			1.00	0.57**	0.15**	0.32**	0.36**	0.45**	0.43**	0.42	0.40**
Computer Attitude, Time 1				1.00	0.07	0.22**	0.49**	0.33**	0.57**	0.31**	0.27**
Usage					1.00	0.09	0.09	0.08	0.08	0.26**	0.18**
Computer Self-Efficacy, Time 2						1.00	0.40**	0.40**	0.41**	0.35**	0.45**
Computer Self-Efficacy, Time 2							1.00	0.51**	0.60**	0.26**	0.37**
Perceived Ease of Use, Time 2								1.00	0.64**	0.28**	0.49**
Computer Attitude, Time 2									1.00	0.19**	0.43**
Beginning of Course Self-Rated Performance										1.00	0.56**
End of Course Self-Rated Performance											1.00

* Correlation is significant at the .05 level (2-tailed)

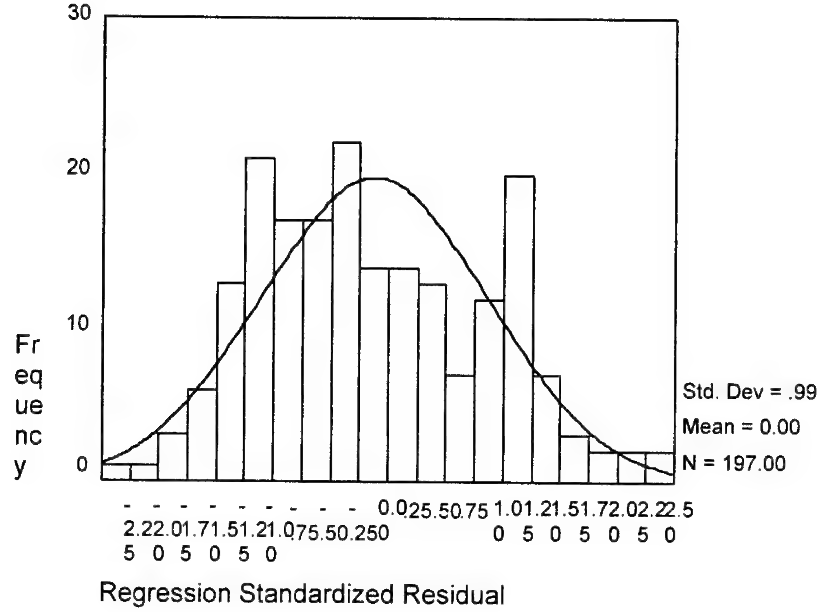
** Correlation is significant at the .01 level (2-tailed)

Appendix D: Self-Rated Performance Linear Regression Models

DEPENDENT VARIABLE: Beginning Of Course Performance (Time 1)
INDEPENDENT VARIABLES: Beginning Of Course Measures (Time 1)

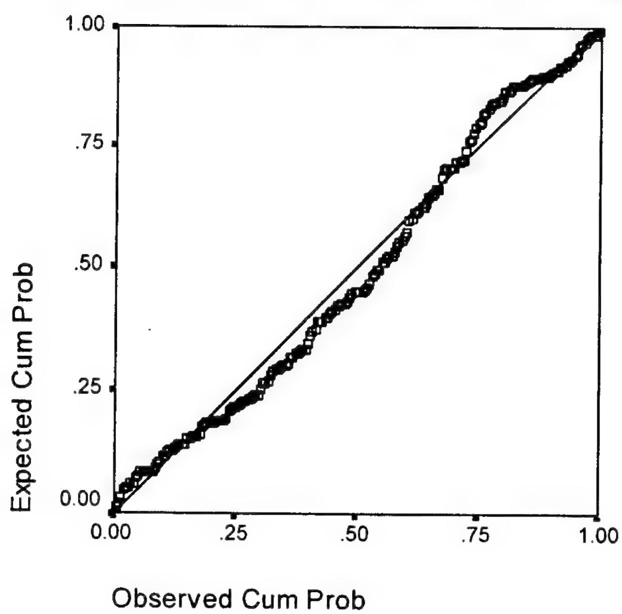
Dependent Variable

Beginning of Course Self-Rated Performance



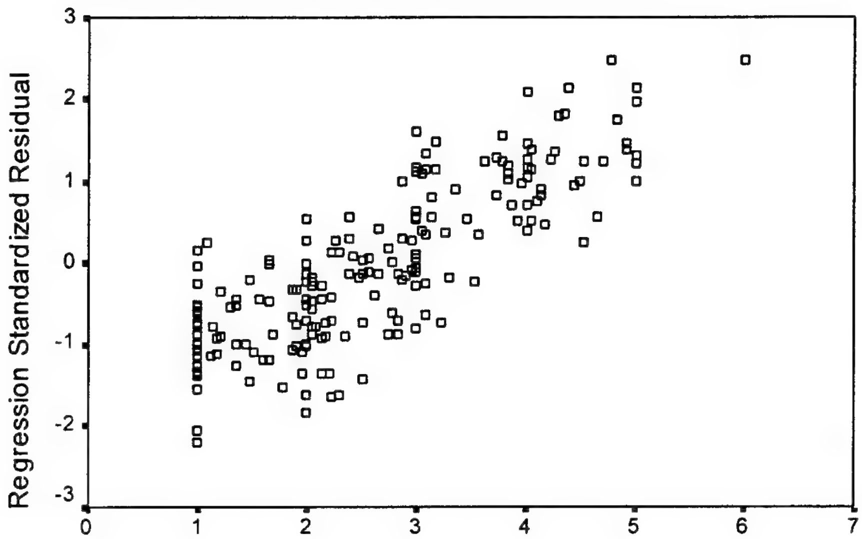
Normal P-P Plot: Standardized Residual

Beginning of Course Self-Rated Performance



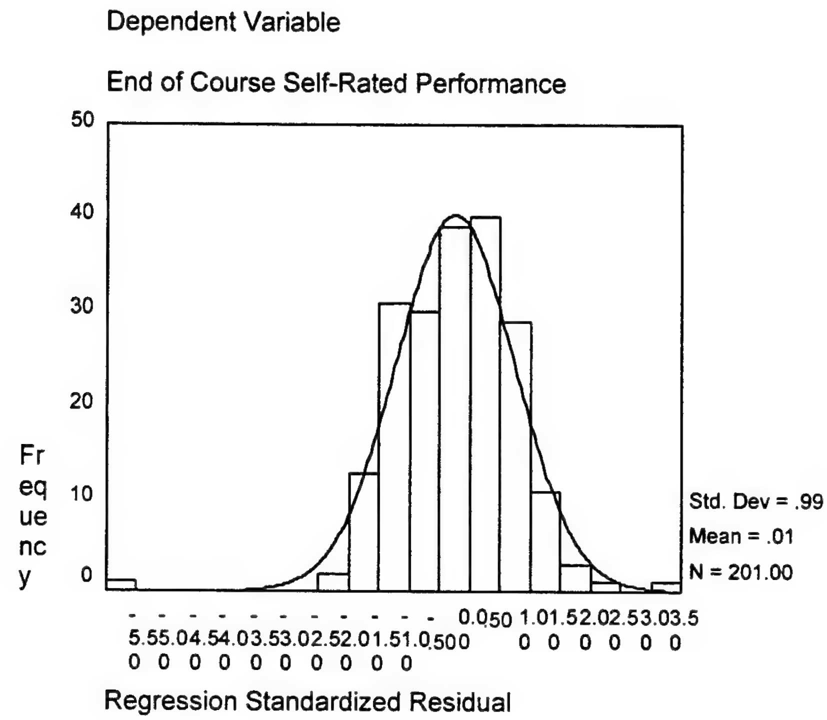
Scatterplot

Beginning of Course Self-Rated Performance



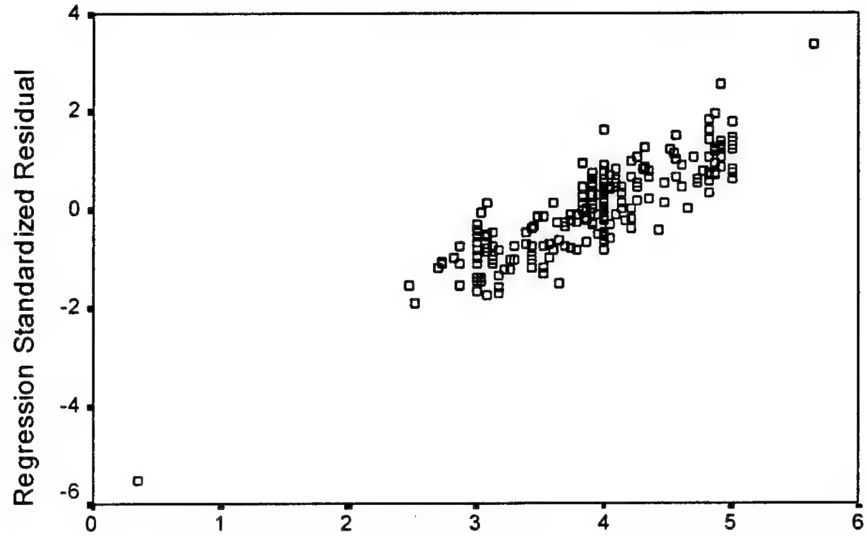
Beginning of Course Self-Rated Performance

DEPENDENT VARIABLE: End Of Course Performance (Time 2)
INDEPENDENT VARIABLES: Beginning Of Course Measures (Time 1)



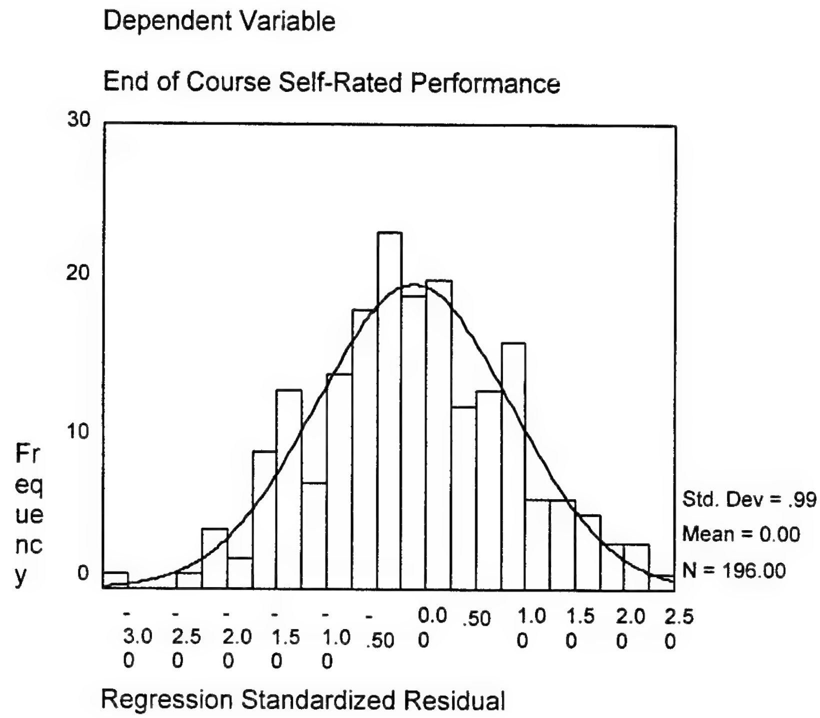
Scatterplot

End of Course Self-Rated Performance



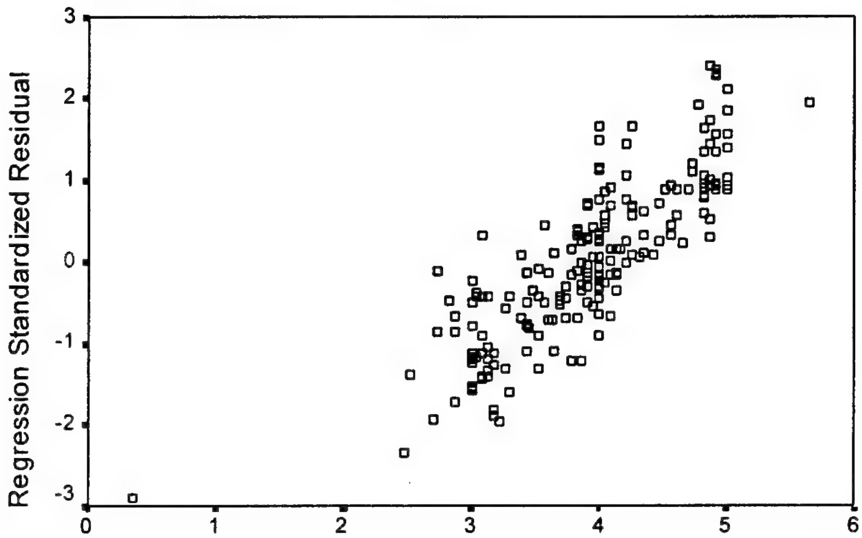
End of Course Self-Rated Performance

DEPENDENT VARIABLE: End Of Course Performance (Time 2)
INDEPENDENT VARIABLES: End Of Course Measures (Time 2)



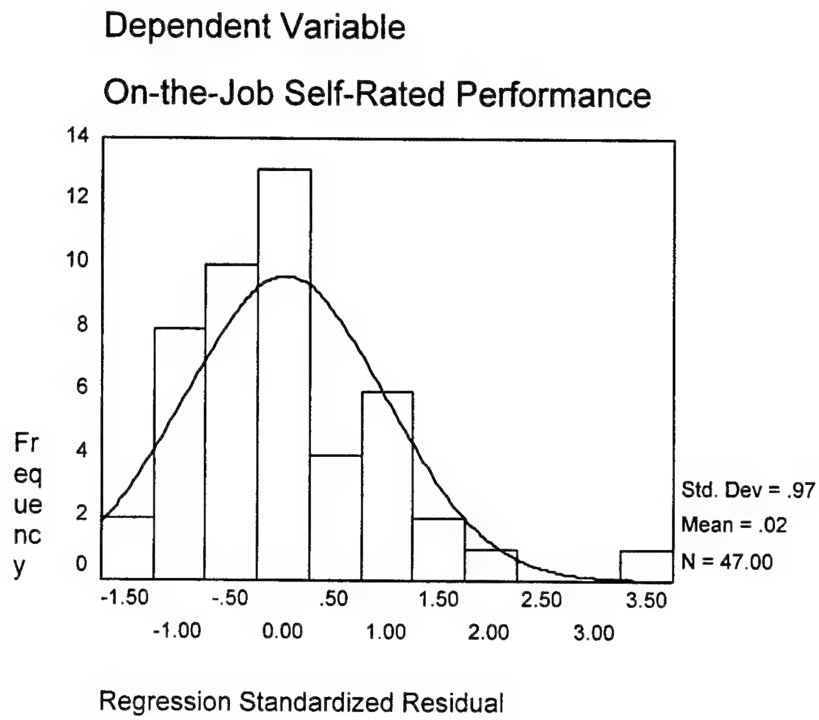
Scatterplot

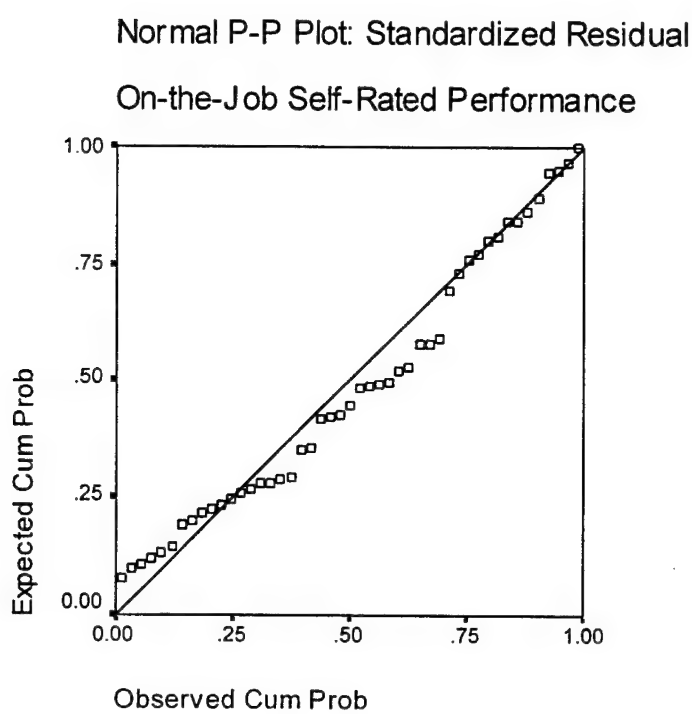
End of Course Self-Rated Performance



End of Course Self-Rated Performance

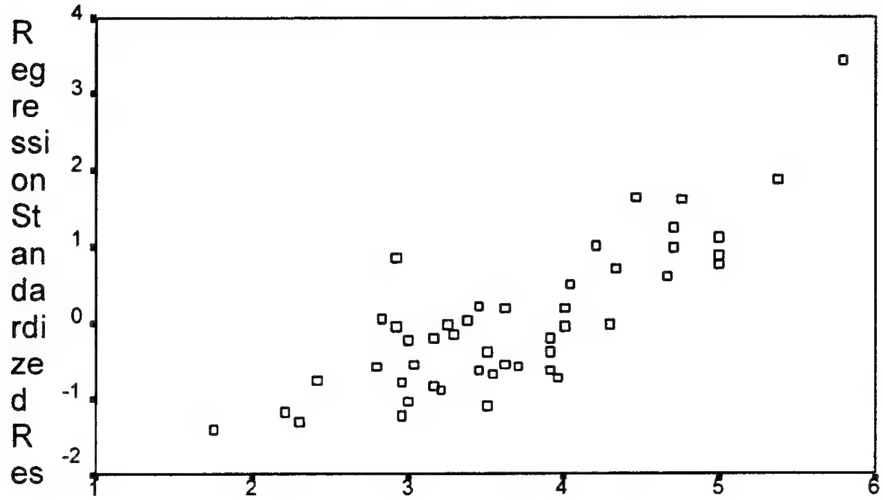
DEPENDENT VARIABLE: On-The-Job Performance (Time 3)
INDEPENDENT VARIABLES: Beginning Of Course Measures (Time 1)





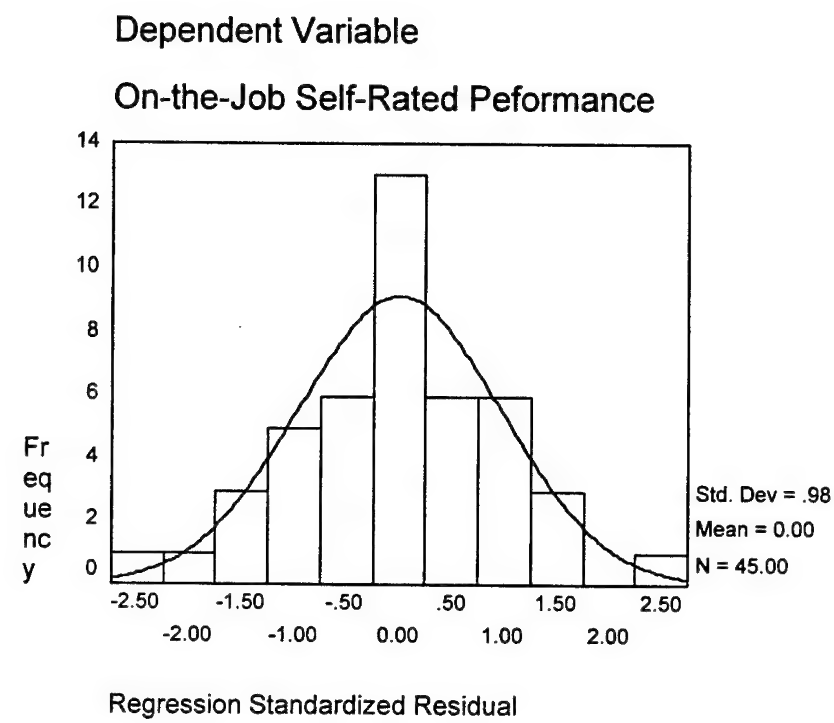
Scatterplot

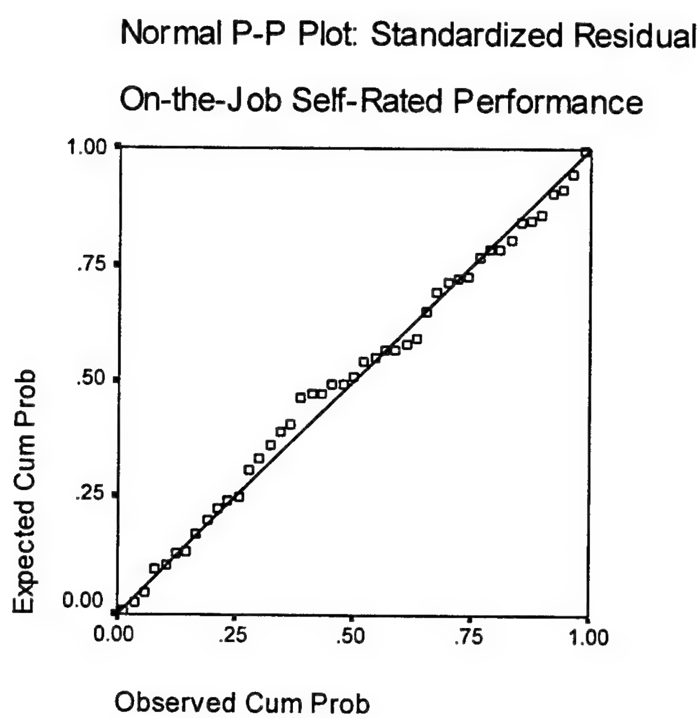
On-the-Job Self-Rated Performance



SP_3

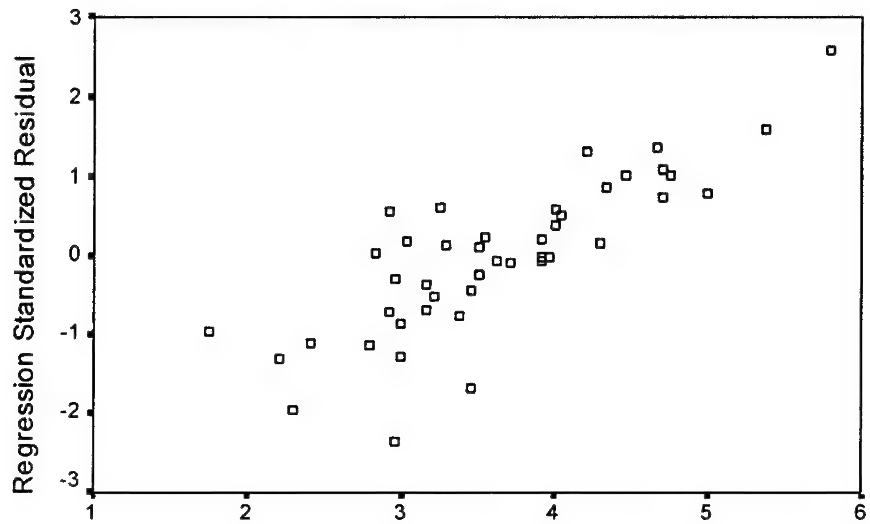
DEPENDENT VARIABLE: On-The-Job Performance (Time 3)
INDEPENDENT VARIABLES: End Of Course Measures (Time 2)





Scatterplot

On-the-Job Self-Rated Performance

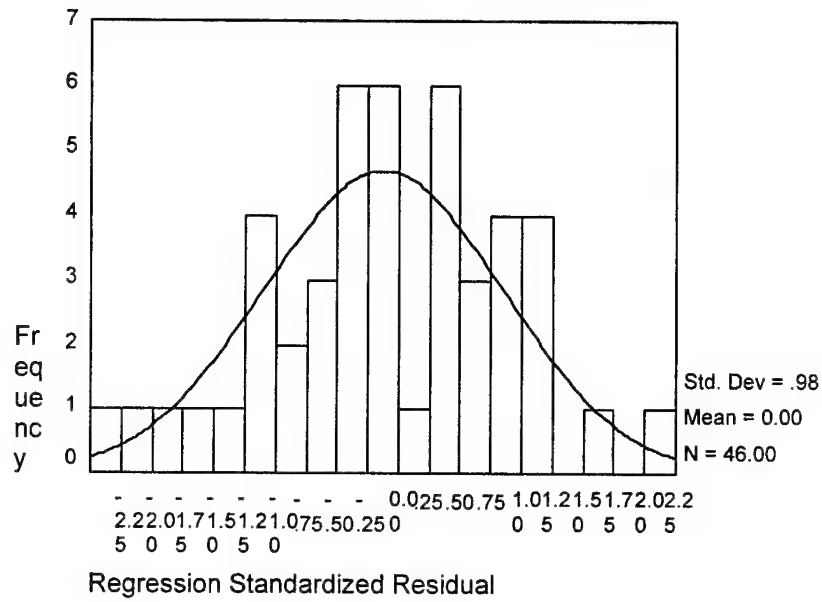


On-the-Job Self-Rated Performance

DEPENDENT VARIABLE: On-The-Job Performance (Time 3)
INDEPENDENT VARIABLES: On-The-Job Measures (Time 3)

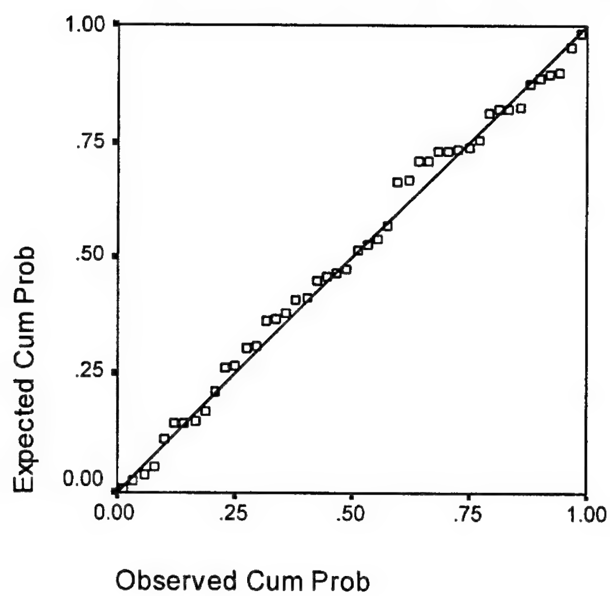
Dependent Variable

On-the-Job Self-Rated Performance



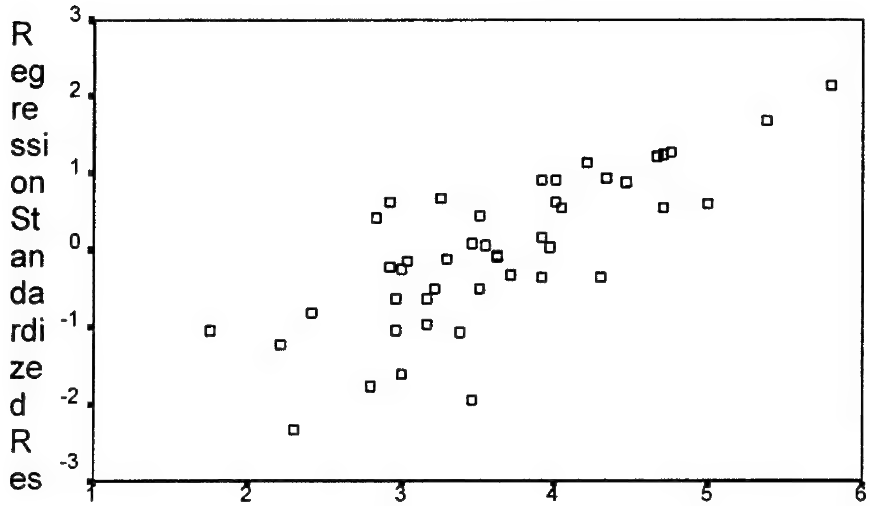
Normal P-P Plot: Standardized Residual

On-the-Job Self-Rated Performance



Scatterplot

On-the-Job Self-Rated Performance



On-the-Job Self-Rated Peformance

Appendix E: C2IPS Surveys

AFIT SURVEY OF C2IPS TRAINING
(SAP3/SYSAD)

USAF Survey Control Number:
USAF SCN 98-33

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY (AETC)
AIR FORCE INSTITUTE OF TECHNOLOGY

Information
About this Research Study

Thank you for agreeing to participate in this research study. Your training here as well as work experience will make an important contribution to the goals of this study.

Description of the study: The purpose of this study is to measure the impact of C2IPS training.

How your responses will be used: The results will be used to establish metrics for C2IPS training course assessment.

Confidentiality of your responses: This information is being collected for research purposes only. No one in your unit, base, or MAJCOM will ever see your individual responses.

PRIVACY ACT STATEMENT

In accordance with AFI 12-35, paragraph 8, the following information is provided as required by the Privacy Act of 1974.

Authority: 10 U.S.C. 8012, Secretary of the Air Force; powers and duties; delegation by; implemented by AFI 30-23, Air Force Personnel Survey Program.

Purpose: This survey is being conducted to collect demographic, affective, learning, and behavioral data regarding C2IPS training. This data will be analyzed to determine the interrelationships of these data and their impact on C2IPS training.

Routine Use: Future C2IPS training can draw upon techniques proven to improve C2IPS operator and system administrator performance in the field. No analysis of individual responses will be conducted and ONLY members of the research team will be permitted to access the raw data. Reports summarizing trends in C2IPS training may be published. *No individual will be identified to anyone outside of the research team.*

Participation: Participation is voluntary. No adverse action will be taken against any member who does not participate in this survey or who does not complete any part of this survey.

Contact Information

If you have any questions, please feel free to contact me:

Capt Joe Scherrer
AFIT/LAS
2950 P Street
Wright-Patterson AFB, OH 45433-7765

email: jscherre@afit.af.mil
DSN: 785-7777 ext. 2136

INSTRUCTIONS

This questionnaire contains 41 items (individual "questions"). All items must be answered by filling in the appropriate spaces on the machine-scored response sheets provided. If for any item you do not find a response that fits your situation exactly, use the one that is closest to the one that meets your situation.

Please use a "soft-lead" (No. 2) pencil, and observe the following:

1. **IMPORTANT**: For identification purposes, fill in the last 4 digits of your Social Security number in the rightmost part of the "IDENTIFICATION NUMBER" section on the answer sheet.

2. Answer all questions. Make heavy black marks that fill in the numbered circle which represents your response.

3. Erase cleanly any responses you wish to change.

4. Make no stray markings of any kind on the response sheet.

5. Do not staple, fold, or tear the response sheet.

6. Do not make any markings on the questionnaire sheet.

You have been provided with one answer sheet. Do NOT fill in your name on the answer sheet so that your responses will be anonymous.

Each answer sheet item provides 10 response items. Some questionnaire items may require a response from 1-7 or 1-5 only. Therefore, be careful to fill in the appropriate response.

The following items ask you to indicate your confidence in whether you could use C2IPS under a variety of conditions. For each of the following conditions, indicate your confidence about your judgment by choosing a number from 1 to 9, where 1 indicates "Not at all confident", 5 indicates "Moderately confident," and 9 indicates "Totally confident".

For example, consider the following sample item:

I COULD COMPLETE THE JOB USING C2IPS…

…if there was no one around to tell me what to do as I go. Not at all 1 2 3 4 5 6 7 8 9 Totally

Confident

Confident

I could perform my assignment/duties using C2IPS…

1. if there was no one around to tell me what to do as I go.
2. if I had never used a system like C2IPS before.
3. if I had only the C2IPS user manuals for reference.
4. if I had seen someone using C2IPS before trying it myself.
5. if I could call someone for help if I got stuck.
6. if someone else had helped me get started.
7. if I had a lot of time to complete the job for which C2IPS was provided.
8. if I had just the built-in help facility for assistance.
9. if someone showed me how to do it first.
10. if I had used similar systems like C2IPS to do the same job.

The following items assess your views about C2IPS. The items are in the form of a short statement accompanied by the 7-point scale shown below. Fill in the circle on your answer sheet which most closely represents your view. For example, consider the following question:

My interaction with C2IPS is understandable. Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

The scale numbers correspond to the following views:

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

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11. Using C2IPS improves my performance on the job.

12. Using C2IPS in my job increases my productivity.

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

13. Using C2IPS enhances my effectiveness in my job.

14. I find C2IPS to be useful in my job.

15. My interaction with C2IPS is understandable.

16. Interacting with C2IPS does not require a lot of mental effort.

17. I find C2IPS to be easy to use.

18. I find it easy to get C2IPS to do what I want it to do.

The next four questions each have a different scale:

19. Using C2IPS is a _________ idea. Bad 1 2 3 4 5 6 7 Good

20. Using C2IPS is a _________ idea. Foolish 1 2 3 4 5 6 7 Wise

21. I _________ the idea of using C2IPS. Dislike 1 2 3 4 5 6 7 Like

22. Using C2IPS is ________. Unpleasant 1 2 3 4 5 6 7 Pleasant

Following is a generalized list of standard AMC C2IPS system administrator tasks. Use 5-point scale shown below to rate yourself on your ability to perform these tasks.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

A rating of "3" indicates your performance is "in the middle" of those with similar experience and skill level.

How well do you...

23. ...configure IPS Local Area Network components?

23. ...enter operating system commands for basic operations?

24. ...enter operating system commands to manipulate software elements?

25. ...create an automated command procedure?

23. ...perform disk management tasks?

24. ...configure network operating system software in accordance with established guidelines?

25. ...perform internet addressing?

26. ...perform TCP/IP procedures?

27. ...configure the Local Area Network?

28. ...configure the Wide Area Network (WAN) subsystem for global operation?

29. ...perform VMS system backup and environment modification?

30. ...perform SMC system administration tasks?

31. ...establish node communications parameters?

32. ...supervise system operations?

33. ...execute SQL statements to retrieve and display database information?

34. ...manage IPS database integrity?

35. ...perform C2IPS security implementation procedures?

36. ...perform C2 IPS security maintenance procedures?

37. ...configure IPS application software?

38. ...operate IPS application software?

39. ...perform fault isolation?

40. ...perform restoration functions?

The following question asks you to make an overall assessment of your C2IPS performance. Use the 5-point rating scale outlined below to rate yourself on your overall performance on C2IPS.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

41. Overall, how do you rate your C2IPS performance?

AFIT SURVEY OF C2IPS TRAINING
(RP3/SYSAD)

USAF Survey Control Number:
USAF SCN 98-33

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY (AETC)
AIR FORCE INSTITUTE OF TECHNOLOGY

Information
About this Research Study

Thank you for agreeing to participate in this research study. Your work experience will make an important contribution to the goals of this study.

Description of the study: The purpose of this study is to measure the impact of C2IPS training.

How your responses will be used: The results will be correlated with previous surveys conducted during C2IPS training to establish metrics for C2IPS training course assessment and improve C2IPS performance in the field.

Confidentiality of your responses: This information is being collected for research purposes only. No one in your unit, base, or MAJCOM will ever see your individual responses.

PRIVACY ACT STATEMENT

In accordance with AFI 12-35, paragraph 8, the following information is provided as required by the Privacy Act of 1974.

Authority: 10 U.S.C. 8012, Secretary of the Air Force; powers and duties; delegation by; implemented by AFI 30-23, Air Force Personnel Survey Program.

Purpose: This survey is being conducted to collect demographic, affective, learning, and behavioral data regarding C2IPS training. This data will be analyzed to determine the interrelationships of these data and their impact on C2IPS training.

Routine Use: Future C2IPS training can draw upon techniques proven to improve C2IPS operator and system administrator performance in the field. No analysis of individual responses will be conducted and ONLY members of the research team will be permitted to access the raw data. Reports summarizing trends in C2IPS training may be published. *No individual will be identified to anyone outside of the research team.*

Participation: Participation is voluntary. No adverse action will be taken against any member who does not participate in this survey or who does not complete any part of this survey.

Contact Information

If you have any questions, please feel free to contact me:

Capt Joe Scherrer
AFIT/LAS
2950 P Street
Wright-Patterson AFB, OH 45433-7765

email: jscherre@afit.af.mil
DSN: 785-7777 ext. 2136

INSTRUCTIONS

This questionnaire contains 23 items (individual "questions"). All items must be answered by filling in the appropriate spaces on the machine-scored response sheets provided. If for any item you do not find a response that fits your situation exactly, use the one that is closest to the one that meets your situation.

Please use a "soft-lead" (No. 2) pencil, and observe the following:

1. Answer all questions. Make heavy black marks that fill in the numbered circle which represents your response.

2. Erase cleanly any responses you wish to change.

3. Make no stray markings of any kind on the response sheet.

4. Do not staple, fold, or tear the response sheet.

5. Do not make any markings on the questionnaire sheet.

You have been provided with one answer sheet. Do NOT fill in your name so that your responses will be anonymous.

Each response has 10 circles (numbered 1 through 10). Some questionnaire items may require a response from 1-5 only. Therefore, be careful to fill in the appropriate response.

Following is a generalized list of standard AMC C2IPS system administrator tasks. Rate this individual on his/her overall ability to perform these C2IPS tasks. Take into consideration any performance changes you attribute to recent C2IPS training, previous C2IPS experience, and the individual's performance on the tasks when compared with individuals of similar experience and skill level. If the individual has been recently assigned, use your best judgment in assigning your ratings. Use the following 5-point scale to record your ratings:

(1) Performs well below average
(2) Performs below average
(3) Performs average
(4) Performs above average
(6) Performs well above average

A rating of "3" should indicate the individual's performance is "in the middle" of those with similar experience and skill level.

How well does the individual...

1. ...configure IPS Local Area Network components?

2. ...enter operating system commands for basic operations?

3. ...enter operating system commands to manipulate software elements?

4. ...create an automated command procedure?

5. ...perform disk management tasks?

6. ...configure network operating system software IAW AMC/local guidelines?

7. ...perform internet addressing?

8. ...perform TCP/IP procedures?

9. ...configure the Local Area Network?

10. ...configure the Wide Area Network (WAN) subsystem for global operation?

11. ...perform VMS system backup and environment modification?

12. ...perform SMC system administration tasks?

13. ...establish node communications parameters?

(1) Performs well below average
(2) Performs below average
(3) Performs average
(4) Performs above average
(5) Performs well above average

14. ...supervise system operations?

15. ...execute SQL statements to retrieve and display database information?

16. ...manage IPS database integrity?

17. ...perform C2IPS security implementation procedures?

18. ...perform C2 IPS security maintenance procedures?

19. ...configure IPS application software?

20. ...operate IPS application software?

21. ...perform fault isolation?

22. ...perform restoration functions?

The following question asks you to make an overall assessment of the individual's C2IPS performance. Use the 5-point rating scale described below.

(1) Performs well below average
(2) Performs below average
(3) Performs average
(4) Performs above average
(5) Performs well above average

23. Overall, how do you rate the individual's C2IPS performance?

AFIT ON-THE JOB SURVEY
OF C2IPS TRAINING
(SAP3/OPS)

USAF Survey Control Number:
USAF SCN 98-33

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY (AETC)
AIR FORCE INSTITUTE OF TECHNOLOGY

Information
About this Research Study

Thank you for agreeing to participate in this research study. Your training here as well as work experience will make an important contribution to the goals of this study.

Description of the study: The purpose of this study is to measure the impact of C2IPS training.

How your responses will be used: The results will be used to establish metrics for C2IPS training course assessment.

Confidentiality of your responses: This information is being collected for research purposes only. No one in your unit, base, or MAJCOM will ever see your individual responses.

PRIVACY ACT STATEMENT

In accordance with AFI 12-35, paragraph 8, the following information is provided as required by the Privacy Act of 1974.

Authority: 10 U.S.C. 8012, Secretary of the Air Force; powers and duties; delegation by; implemented by AFI 30-23, Air Force Personnel Survey Program.

Purpose: This survey is being conducted to collect demographic, affective, learning, and behavioral data regarding C2IPS training. This data will be analyzed to determine the interrelationships of these data and their impact on C2IPS training.

Routine Use: Future C2IPS training can draw upon techniques proven to improve C2IPS operator and system administrator performance in the field. No analysis of individual responses will be conducted and ONLY members of the research team will be permitted to access the raw data. Reports summarizing trends in C2IPS training may be published. *No individual will be identified to anyone outside of the research team.*

Participation: Participation is voluntary. No adverse action will be taken against any member who does not participate in this survey or who does not complete any part of this survey.

Contact Information

If you have any questions, please feel free to contact me:

Capt Joe Scherrer
AFIT/LAS
2950 P Street
Wright-Patterson AFB, OH 45433-7765

email: jscherre@afit.af.mil
DSN: 785-7777 ext. 2136

INSTRUCTIONS

This questionnaire contains 46 items (individual "questions"). All items must be answered by filling in the appropriate spaces on the machine-scored response sheets provided. If for any item you do not find a response that fits your situation exactly, use the one that is closest to the one that meets your situation.

Please use a "soft-lead" (No. 2) pencil, and observe the following:

1. **IMPORTANT**: For identification purposes, fill in the last 4 digits of your Social Security number in the rightmost part of the "IDENTIFICATION NUMBER" section on the answer sheet.

2. Answer all questions. Make heavy black marks that fill in the numbered circle which represents your response.

3. Erase cleanly any responses you wish to change.

4. Make no stray markings of any kind on the response sheet.

5. Do not staple, fold, or tear the response sheet.

6. Do not make any markings on the questionnaire sheet.

You have been provided with one answer sheet. Do NOT fill in your name on the answer sheet so that your responses will be anonymous.

Each answer sheet item provides 10 response items. Some questionnaire items may require a response from 1-7 or 1-5 only. Therefore, be careful to fill in the appropriate response.

The following items ask you to indicate your confidence in whether you could use C2IPS under a variety of conditions. For each of the following conditions, indicate your confidence about your judgment by choosing a number from 1 to 9, where 1 indicates "Not at all Confident", 5 indicates "Moderately Confident," and 9 indicates "Totally Confident".

For example, consider the following sample item:

I COULD COMPLETE THE JOB USING C2IPS...

...if there was no one around to tell me what to do as I go. Not at all 1 2 3 4 5 6 7 8 9
Totally Confident
Confident

I could perform my assignment/duties using C2IPS...

1. if there was no one around to tell me what to do as I go.
2. if I had never used a system like C2IPS before.
3. if I had only the C2IPS user manuals for reference.
4. if I had seen someone using C2IPS before trying it myself.
5. if I could call someone for help if I got stuck.
6. if someone else had helped me get started.
7. if I had a lot of time to complete the job for which C2IPS was provided.
8. if I had just the built-in help facility for assistance.
9. if someone showed me how to do it first.
10. if I had used similar systems like C2IPS to do the same job.

The following items assess your views about C2IPS. The items are in the form of a short statement accompanied by the 7-point scale shown below. Fill in the circle on your answer sheet which most closely represents your view. For example, consider the following question:

My interaction with C2IPS is understandable. Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

The scale numbers correspond to the following views:

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

---

11. Using C2IPS improves my performance on the job.

12. Using C2IPS in my job increases my productivity.

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

13. Using C2IPS enhances my effectiveness in my job.

14. I find C2IPS to be useful in my job.

15. My interaction with C2IPS is understandable.

16. Interacting with C2IPS does not require a lot of mental effort.

17. I find C2IPS to be easy to use.

18. I find it easy to get C2IPS to do what I want it to do.

The next four questions each have a different scale:

19. Using C2IPS is a __________ idea. Bad 1 2 3 4 5 6 7 Good

20. Using C2IPS is a __________ idea. Foolish 1 2 3 4 5 6 7 Wise

21. I __________ the idea of using C2IPS. Dislike 1 2 3 4 5 6 7 Like

22. Using C2IPS is _________. Unpleasant 1 2 3 4 5 6 7 Pleasant

Following is a generalized list of standard AMC C2IPS operator tasks. Use the 5-point scale shown below to rate yourself on your ability to perform these tasks.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

A rating of "3" indicates your performance is "in the middle" of those with similar experience and skill level.

----------Using C2IPS, how well do you...

23. ...demonstrate sign-on/sign-off procedures?

24. ...interpret the mission summary screen?

25. ...interpret the inbound mission screen?

26. ...interpret the outbound mission screen?

27. ...interpret the mission monitoring screen?

28. ...interpret the mission schedule manage screen?

29. ...interpret incoming messages to review?

30. ...interpret diplomatic clearance information?

31. ...create and transmit an airlift advisory message?

32. ...create and transmit and airlift departure message?

33. ...create and transmit and airlift delay message?

34. ...create and transmit and airlift arrival message?

35. ...interpret a diplomatic clearance status message?

36. ...interpret a mission schedule message?

37. ...revise a single mission?

38. ...interpret the aircraft control and status screen?

39. ...interpret the notice to review screen?

40. ...interpret the ramp status screen?

41. ...receive and transmit the airlift schedule request message?

42. ...assign and update sequence of events (SOE)?

43. ...interpret the incomplete/recurring message screen?

44. ...interpret the outgoing message to approve screen?

45. ...interpret the single mission display screen?

The following question asks you to make an overall assessment of your C2IPS performance. Use the same 5-point rating scale outlined below to rate yourself on your overall performance on C2IPS.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

46. Overall, how do you rate your C2IPS performance?

AFIT SURVEY OF C2IPS TRAINING
(RP3/OPS)

USAF Survey Control Number:
USAF SCN 98-33

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY (AETC)
AIR FORCE INSTITUTE OF TECHNOLOGY

Information
About this Research Study

Thank you for agreeing to participate in this research study. Your work experience will make an important contribution to the goals of this study.

Description of the study: The purpose of this study is to measure the impact of C2IPS training.

How your responses will be used: The results will be correlated with previous surveys conducted during C2IPS training to establish metrics for C2IPS training course assessment and improve C2IPS performance in the field.

Confidentiality of your responses: This information is being collected for research purposes only. No one in your unit, base, or MAJCOM will ever see your individual responses.

PRIVACY ACT STATEMENT

In accordance with AFI 12-35, paragraph 8, the following information is provided as required by the Privacy Act of 1974.

Authority: 10 U.S.C. 8012, Secretary of the Air Force; powers and duties; delegation by; implemented by AFI 30-23, Air Force Personnel Survey Program.

Purpose: This survey is being conducted to collect demographic, affective, learning, and behavioral data regarding C2IPS training. This data will be analyzed to determine the interrelationships of these data and their impact on C2IPS training.

Routine Use: Future C2IPS training can draw upon techniques proven to improve C2IPS operator and system administrator performance in the field. No analysis of individual responses will be conducted and ONLY members of the research team will be permitted to access the raw data. Reports summarizing trends in C2IPS training may be published. *No individual will be identified to anyone outside of the research team.*

Participation: Participation is voluntary. No adverse action will be taken against any member who does not participate in this survey or who does not complete any part of this survey.

Contact Information

If you have any questions, please feel free to contact me:

Capt Joe Scherrer
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2950 P Street
Wright-Patterson AFB, OH 45433-7765

email: jscherre@afit.af.mil
DSN: 785-7777 ext. 2136

INSTRUCTIONS

This questionnaire contains 24 items (individual "questions"). All items must be answered by filling in the appropriate spaces on the machine-scored response sheets provided. If for any item you do not find a response that fits your situation exactly, use the one that is closest to the one that meets your situation.

Please use a "soft-lead" (No. 2) pencil, and observe the following:

1. Answer all questions. Make heavy black marks that fill in the numbered circle which represents your response.

2. Erase cleanly any responses you wish to change.

3. Make no stray markings of any kind on the response sheet.

4. Do not staple, fold, or tear the response sheet.

5. Do not make any markings on the questionnaire sheet.

You have been provided with one answer sheet. Do NOT fill in your name so that your responses will be anonymous.

Each response has 10 circles (numbered 1 through 10). Some questionnaire items may require a response from 1-5 only. Therefore, be careful to fill in the appropriate response.

Following is a generalized list of standard AMC C2IPS operator tasks. Rate this individual on his/her overall ability to perform these C2IPS tasks. Take into consideration any performance changes you attribute to recent C2IPS training, previous C2IPS experience, and the individual's performance on the tasks when compared with individuals of similar experience and skill level. If the individual has been recently assigned, use your best judgment in assigning your ratings. Use the following 5-point scale to indicate your ratings:

(1) Performs well below average
(2) Performs below average
(3) Performs average
(4) Performs above average
(5) Performs well above average

A rating of "3" should indicate the individual's performance is "in the middle" of those with similar experience and skill level.

Using C2IPS, how well does the individual...

1. ...demonstrate sign-on/sign-off procedures?

2. ...interpret the mission summary screen?

3. ...interpret the inbound mission screen?

4. ...interpret the outbound mission screen?

5. ...interpret the mission monitoring screen?

6. ...interpret the mission schedule manage screen?

7. ...interpret incoming messages to review?

8. ...interpret diplomatic clearance information?

9. ...create and transmit an airlift advisory message?

10. ...create and transmit and airlift departure message?

11. ...create and transmit and airlift delay message?

12. ...create and transmit and airlift arrival message?

13. ...interpret a diplomatic clearance status message?

(1) Performs well below average
(2) Performs below average
(3) Performs average
(4) Performs above average
(5) Performs well above average

14. …interpret a mission schedule message?

15. …revise a single mission?

16. …interpret the aircraft control and status screen?

17. …interpret the notice to review screen?

18. …interpret the ramp status screen?

19. …receive and transmit the airlift schedule request message?

20. …assign and update sequence of events (SOE)?

21. …interpret the incomplete/recurring message screen?

22. …interpret the outgoing message to approve screen?

23. …interpret the single mission display screen?

The following question asks you to make an overall assessment of the individual's C2IPS performance. Use the 5-point rating scale described below.

(1) Performs well below average
(2) Performs below average
(3) Performs average
(4) Performs above average
(5) Performs well above average

24. Overall, how do you rate the individual's C2IPS performance?

AFIT END OF COURSE SURVEY OF C2IPS TRAINING (SAP2/SYSAD)

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY (AETC)
AIR FORCE INSTITUTE OF TECHNOLOGY

Information
About this Research Study

Thank you for agreeing to participate in this research study. Your training here as well as work experience will make an important contribution to the goals of this study.

Description of the study: The purpose of this study is to measure the impact of C2IPS training.

How your responses will be used: The results will be used to establish metrics for C2IPS training course assessment.

Confidentiality of your responses: This information is being collected for research purposes only. No one in your unit, base, or MAJCOM will ever see your individual responses.

PRIVACY ACT STATEMENT

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Purpose: This survey is being conducted to collect demographic, affective, learning, and behavioral data regarding C2IPS training. This data will be analyzed to determine the interrelationships of these data and their impact on C2IPS training.

Routine Use: Future C2IPS training can draw upon techniques proven to improve C2IPS operator and system administrator performance in the field. No analysis of individual responses will be conducted and ONLY members of the research team will be permitted to access the raw data. Reports summarizing trends in C2IPS training may be published. *No individual will be identified to anyone outside of the research team.*

Participation: Participation is voluntary. No adverse action will be taken against any member who does not participate in this survey or who does not complete any part of this survey.

Contact Information

If you have any questions, please feel free to contact me:

Capt Joe Scherrer
AFIT/LAS
2950 P Street
Wright-Patterson AFB, OH 45433-7765

email: jscherrer@afit.af.mil
DSN: 785-2910

INSTRUCTIONS

This questionnaire contains 68 items (individual "questions"). All items must be answered by filling in the appropriate spaces on the machine-scored response sheets provided. If for any item you do not find a response that fits your situation exactly, use the one that is closest to the one that meets your situation.

Please use a "soft-lead" (No. 2) pencil, and observe the following:

1. **IMPORTANT**: For identification purposes, fill in the last 4 digits of your Social Security number in the rightmost part of the "IDENTIFICATION NUMBER" section on the answer sheet.

2. Answer all questions. Make heavy black marks that fill in the numbered circle which represents your response.

3. Erase cleanly any responses you wish to change.

4. Make no stray markings of any kind on the response sheet.

5. Do not staple, fold, or tear the response sheet.

6. Do not make any markings on the questionnaire sheet.

You have been provided with one answer sheet. Do NOT fill in your name on the answer sheet so that your responses will be anonymous.

Each answer sheet item provides 10 response items. Some questionnaire items may require a response from 1-7 or 1-5 only. Therefore, be careful to fill in the appropriate response.

The following items ask you to indicate your confidence in whether you could use C2IPS under a variety of conditions. For each of the following conditions, indicate your confidence about your judgment by choosing a number from 1 to 9, where 1 indicates "Not at all Confident", 5 indicates "Moderately Confident," and 9 indicates "Totally Confident".

For example, consider the following sample item:

I COULD COMPLETE THE JOB USING C2IPS...

...if there was no one around to tell me what to do as I go. Not at all 1 2 3 4 5 6 7 8 9 Totally

Confident

Confident

I could perform my assignment/duties using C2IPS...

1. if there was no one around to tell me what to do as I go.
2. if I had never used a system like C2IPS before.
3. if I had only the C2IPS user manuals for reference.
4. if I had seen someone using C2IPS before trying it myself.
5. if I could call someone for help if I got stuck.
6. if someone else had helped me get started.
7. if I had a lot of time to complete the job for which C2IPS was provided.
8. if I had just the built-in help facility for assistance.
9. if someone showed me how to do it first.
10. if I had used similar systems like C2IPS to do the same job.

The following items assess your views about C2IPS. The items are in the form of a short statement accompanied by a scale. Fill in the circle on your answer sheet which most closely represents your view. For example, consider the following question:

My interaction with C2IPS is clear and understandable. Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

The scale numbers correspond to the following views:

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

----

11. Using C2IPS improves my performance on the job/in the course.

12. Using C2IPS in my job/in the course increases my productivity.

(TURN PAGE→)

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

13. Using C2IPS enhances my effectiveness in my job/in the course.

14. I find C2IPS to be useful in my job/in the course.

15. My interaction with C2IPS is clear and understandable.

16. Interacting with C2IPS does not require a lot of mental effort.

17. I find C2IPS to be easy to use.

18. I find it easy to get C2IPS to do what I want it to do.

The next four questions each have a different scale:

23. Using C2IPS is a _________ idea.	Bad	1	2	3	4	5	6	7 Good
24. Using C2IPS is a _________ idea.	Foolish	1	2	3	4	5	6	7 Wise
25. I _________ the idea of using C2IPS.	Dislike	1	2	3	4	5	6	7 Like
26. Using C2IPS is ________.	Unpleasant	1	2	3	4	5	6	7 Pleasant

(TURN PAGE→)

Following is a generalized list of standard AMC C2IPS system administrator tasks. GIVEN WHAT YOU NOW KNOW ABOUT C2IPS AFTER YOUR TRAINING, RE-RATE YOUR ABILITY TO PERFORM THESE C2IPS TASKS *AT THE BEGINNING* OF THIS COURSE. Use the 5-point scale shown below to record your ratings:

(1) Performed well below average
(2) Performed below average
(3) Performed average
(4) Performed above average
(5) Performed well above average

A rating of "3" indicates your performance is "in the middle" of those with similar experience and skill level.

At the beginning of this course, how well did you...

23. ...configure IPS Local Area Network components?

24. ...enter operating system commands for basic operations?

25. ...enter operating system commands to manipulate software elements?

26. ...create an automated command procedure?

27. ...perform disk management tasks?

28. ...configure network operating system software in accordance with established guidelines?

29. ...perform internet addressing?

30. ...perform TCP/IP procedures?

31. ...configure the Local Area Network?

32. ...configure the Wide Area Network (WAN) subsystem for global operation?

33. ...perform VMS system backup and environment modification?

34. ...perform SMC system administration tasks?

35. ...establish node communications parameters?

36. ...supervise system operations?

37. ...execute SQL statements to retrieve and display database information?

38. ...manage IPS database integrity?

39. ...perform C2IPS security implementation procedures?

40. ...perform C2 IPS security maintenance procedures?

41. ...configure IPS application software?

42. ...operate IPS application software?

43. ...perform fault isolation?

(TURN PAGE→)

(1) Performed well below average
(2) Performed below average
(3) Performed average
(4) Performed above average
(5) Performed well above average

44. ...perform restoration functions?

The following question asks you to make an overall assessment of your C2IPS performance AT THE BEGINNING OF THS COURSE. Use the 5-point rating scale outlined below.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

41. Overall, how do you rate your C2IPS performance at the beginning of the course?

(TURN PAGE→)

Following is a generalized list of standard AMC C2IPS system administrator tasks. NOW, RATE YOURSELF ON YOUR ABILITY TO PERFORM THESE C2IPS TASKS *AFTER* COMPLETING THIS COURSE. Use the 5-point scale shown below to record your ratings:

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

A rating of "3" indicates your performance is "in the middle" of those with similar experience and skill level.

After completing this course, how well do you…

46. …configure IPS Local Area Network components?

47. …enter operating system commands for basic operations?

48. …enter operating system commands to manipulate software elements?

49. …create an automated command procedure?

50. …perform disk management tasks?

51. …configure network operating system software in accordance with established guidelines?

52. …perform internet addressing?

53. …perform TCP/IP procedures?

54. …configure the Local Area Network?

55. …configure the Wide Area Network (WAN) subsystem for global operation?

56. …perform VMS system backup and environment modification?

57. …perform SMC system administration tasks?

58. …establish node communications parameters?

59. …supervise system operations?

60. …execute SQL statements to retrieve and display database information?

61. …manage IPS database integrity?

62. …perform C2IPS security implementation procedures?

63. …perform C2 IPS security maintenance procedures?

64. …configure IPS application software?

65. …operate IPS application software?

66. …perform fault isolation?

(TURN PAGE→)

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

67. ...perform restoration functions?

The following question asks you to make an overall assessment of your C2IPS performance AFTER COMPLETING THIS COURSE. Use the 5-point rating scale outlined below.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

68. Overall, how do you rate your C2IPS performance after completing this course?

END OF SURVEY

- **ENSURE *ALL* QUESTIONS HAVE BEEN ANSWERED**
- **ENSURE THE LAST 4-DIGITS OF YOUR SSN ARE FILLED IN ON THE ANSWER SHEET**
- **TURN IN THE ANSWER SHEET TO YOUR INSTRUCTOR**

AFIT END OF COURSE SURVEY
OF C2IPS TRAINING
(SAP2/OPS)

USAF Survey Control Number:
USAF SCN 98-33

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY (AETC)
AIR FORCE INSTITUTE OF TECHNOLOGY

Information
About this Research Study

Thank you for agreeing to participate in this research study. Your training here as well as work experience will make an important contribution to the goals of this study.

Description of the study: The purpose of this study is to measure the impact of C2IPS training.

How your responses will be used: The results will be used to establish metrics for C2IPS training course assessment.

Confidentiality of your responses: This information is being collected for research purposes only. No one in your unit, base, or MAJCOM will ever see your individual responses.

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Purpose: This survey is being conducted to collect demographic, affective, learning, and behavioral data regarding C2IPS training. This data will be analyzed to determine the interrelationships of these data and their impact on C2IPS training.

Routine Use: Future C2IPS training can draw upon techniques proven to improve C2IPS operator and system administrator performance in the field. No analysis of individual responses will be conducted and ONLY members of the research team will be permitted to access the raw data. Reports summarizing trends in C2IPS training may be published. *No individual will be identified to anyone outside of the research team.*

Participation: Participation is voluntary. No adverse action will be taken against any member who does not participate in this survey or who does not complete any part of this survey.

Contact Information

If you have any questions, please feel free to contact me:

Capt Joe Scherrer
AFIT/LAS
2950 P Street
Wright-Patterson AFB, OH 45433-7765

email: jscherrer@afit.af.mil
DSN: 785-2910

INSTRUCTIONS

This questionnaire contains 70 items (individual "questions"). All items must be answered by filling in the appropriate spaces on the machine-scored response sheets provided. If for any item you do not find a response that fits your situation exactly, use the one that is closest to the one that meets your situation.

Please use a "soft-lead" (No. 2) pencil, and observe the following:

1. **IMPORTANT**: For identification purposes, fill in the last 4 digits of your Social Security number in the rightmost part of the "IDENTIFICATION NUMBER" section on the answer sheet.

2. Answer all questions. Make heavy black marks that fill in the numbered circle which represents your response.

3. Erase cleanly any responses you wish to change.

4. Make no stray markings of any kind on the response sheet.

5. Do not staple, fold, or tear the response sheet.

6. Do not make any markings on the questionnaire sheet.

You have been provided with one answer sheet. Do NOT fill in your name on the answer sheet so that your responses will be anonymous.

Each answer sheet item provides 10 response items. Some questionnaire items may require a response from 1-7 or 1-5 only. Therefore, be careful to fill in the appropriate response.

The following items ask you to indicate your confidence in whether you could use C2IPS under a variety of conditions. For each of the following conditions, indicate your confidence about your judgment by choosing a number from 1 to 9, where 1 indicates "Not at all Confident", 5 indicates "Moderately Confident," and 9 indicates "Totally Confident".

For example, consider the following sample item:

I COULD COMPLETE THE JOB USING C2IPS...

...if there was no one around to tell me what to do as I go. Not at all 1 2 3 4 5 6 7 8 9 Totally

Confident

Confident

I could perform my assignment/duties using C2IPS...

1. if there was no one around to tell me what to do as I go.
2. if I had never used a system like C2IPS before.
3. if I had only the C2IPS user manuals for reference.
4. if I had seen someone using C2IPS before trying it myself.
5. if I could call someone for help if I got stuck.
6. if someone else had helped me get started.
7. if I had a lot of time to complete the job for which C2IPS was provided.
8. if I had just the built-in help facility for assistance.
9. if someone showed me how to do it first.
10. if I had used similar systems like C2IPS to do the same job.

The following items assess your views about C2IPS. The items are in the form of a short statement accompanied by a scale. Fill in the circle on your answer sheet which most closely represents your view. For example, consider the following question:

My interaction with C2IPS is understandable. Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

The scale numbers correspond to the following views:

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

---

11. Using C2IPS improves my performance on the job.

12. Using C2IPS in my job increases my productivity.

(TURN PAGE→)

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

13. Using C2IPS enhances my effectiveness in my job.

14. I find C2IPS to be useful in my job.

15. My interaction with C2IPS is understandable.

16. Interacting with C2IPS does not require a lot of mental effort.

17. I find C2IPS to be easy to use.

18. I find it easy to get C2IPS to do what I want it to do.

The next four questions each have a different scale:

19. Using C2IPS is a __________ idea.	Bad	1	2	3	4	5	6	7 Good
20. Using C2IPS is a __________ idea.	Foolish	1	2	3	4	5	6	7 Wise
21. I __________ the idea of using C2IPS.	Dislike	1	2	3	4	5	6	7 Like
22. Using C2IPS is _________.	Unpleasant	1	2	3	4	5	6	7 Pleasant

(TURN PAGE→)

Following is a generalized list of standard AMC C2IPS operator tasks. GIVEN WHAT YOU NOW KNOW ABOUT C2IPS AFTER YOUR TRAINING, RE-RATE YOUR ABILITY TO PERFORM THESE C2IPS TASKS *BEFORE THE BEGINNING* OF THIS COURSE. Use the 5-point scale shown below to record your ratings.

(1) Performed well below average
(2) Performed below average
(3) Performed average
(4) Performed above average
(5) Performed well above average

A rating of "3" indicates your performance is "in the middle" of those with similar experience and skill level.

---------Before the beginning of this course, how well did you...

23. ...demonstrate sign-on/sign-off procedures?

24. ...interpret the mission summary screen?

25. ...interpret the inbound mission screen?

26. ...interpret the outbound mission screen?

27. ...interpret the mission monitoring screen?

28. ...interpret the mission schedule manage screen?

29. ...interpret incoming messages to review?

30. ...interpret diplomatic clearance information?

31. ...create and transmit an airlift advisory message?

32. ...create and transmit and airlift departure message?

33. ...create and transmit and airlift delay message?

34. ...create and transmit and airlift arrival message?

35. ...interpret a diplomatic clearance status message?

36. ...interpret a mission schedule message?

37. ...revise a single mission?

38. ...interpret the aircraft control and status screen?

39. ...interpret the notice to review screen?

40. ...interpret the ramp status screen?

41. ...receive and transmit the airlift schedule request message?

42. ...assign and update sequence of events (SOE)?

43. …interpret the incomplete/recurring message screen?

(1) Performed well below average
(2) Performed below average
(3) Performed average
(4) Performed above average
(5) Performed well above average

44. …interpret the outgoing message to approve screen?

45. …interpret the single mission display screen?

The following question asks you to make an overall assessment of your C2IPS performance. Use the same 5-point rating scale outlined below to re-rate yourself on your overall performance on C2IPS BEFORE BEGINNING THIS COURSE.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

46. Overall, how do you rate your C2IPS performance before beginning this course?

(TURN PAGE→)

Following is a generalized list of standard AMC C2IPS operator tasks. NOW, RATE YOURSELF ON YOUR ABILITY TO PERFORM THESE C2IPS TASKS *AFTER* COMPLETING THIS COURSE. Use the 5-point scale shown below to record your ratings:

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(6) Perform well above average

A rating of "3" indicates your performance is "in the middle" of those with similar experience and skill level.

After completing this course, how well do you...

47. ...demonstrate sign-on/sign-off procedures?

48. ...interpret the mission summary screen?

49. ...interpret the inbound mission screen?

50. ...interpret the outbound mission screen?

51. ...interpret the mission monitoring screen?

52. ...interpret the mission schedule manage screen?

53. ...interpret incoming messages to review?

54. ...interpret diplomatic clearance information?

55. ...create and transmit an airlift advisory message?

56. ...create and transmit and airlift departure message?

57. ...create and transmit and airlift delay message?

58. ...create and transmit and airlift arrival message?

59. ...interpret a diplomatic clearance status message?

60. ...interpret a mission schedule message?

61. ...revise a single mission?

62. ...interpret the aircraft control and status screen?

63. ...interpret the notice to review screen?

64. ...interpret the ramp status screen?

65. ...receive and transmit the airlift schedule request message?

66. ...assign and update sequence of events (SOE)?

67. ...interpret the incomplete/recurring message screen? (TURN PAGE→)

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

68. ...interpret the outgoing message to approve screen?

69. ...interpret the single mission display screen?

The following question asks you to make an overall assessment of your C2IPS performance AFTER COMPLETING THIS COURSE. Use the 5-point rating scale outlined below.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

70. Overall, how do you rate your C2IPS performance after completing this course?

END OF SURVEY

- **ENSURE *ALL* QUESTIONS HAVE BEEN ANSWERED**

- **ENSURE THE LAST 4-DIGITS OF YOUR SSN ARE FILLED IN ON THE ANSWER SHEET**

TURN IN THE ANSWER SHEET TO YOUR INSTRUCTOR

AFIT BEGINNING OF COURSE SURVEY
OF C2IPS TRAINING
(SAP1/SYSAD)

USAF Survey Control Number:
USAF SCN 98-33

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY (AETC)
AIR FORCE INSTITUTE OF TECHNOLOGY

Information
About this Research Study

Thank you for agreeing to participate in this research study. Your training here as well as work experience will make an important contribution to the goals of this study.

Description of the study: The purpose of this study is to measure the impact of C2IPS training.

How your responses will be used: The results will be used to establish metrics for C2IPS training course assessment.

Confidentiality of your responses: This information is being collected for research purposes only. No one in your unit, base, or MAJCOM will ever see your individual responses.

PRIVACY ACT STATEMENT

In accordance with AFR 12-35, paragraph 8, the following information is provided as required by the Privacy Act of 1974.

Authority: 10 U.S.C. 8012, Secretary of the Air Force; powers and duties; delegation by; implemented by AFR 30-23, Air Force Personnel Survey Program.

Purpose: This survey is being conducted to collect demographic, affective, learning, and behavioral data regarding C2IPS training. This data will be analyzed to determine the interrelationships of these data and their impact on C2IPS training.

Routine Use: Future C2IPS training can draw upon techniques proven to improve C2IPS operator and system administrator performance in the field. No analysis of individual responses will be conducted and ONLY members of the research team will be permitted to access the raw data. Reports summarizing trends in C2IPS training may be published. *No individual will be identified to anyone outside of the research team.*

Participation: Participation is voluntary. No adverse action will be taken against any member who does not participate in this survey or who does not complete any part of this survey.

Contact Information

If you have any questions, please feel free to contact me:

Capt Joe Scherrer
AFIT/LAS
2950 P Street
Wright-Patterson AFB, OH 45433-7765

email: jscherrer@afit.af.mil
DSN: 785-2910

INSTRUCTIONS

This questionnaire contains 53 items (individual "questions"). All items must be answered by filling in the appropriate spaces on the machine-scored response sheets provided. If for any item you do not find a response that fits your situation exactly, use the one that is closest to the one that meets your situation.

1. Please use a "soft-lead" (No. 2) pencil, and observe the following:

2. **IMPORTANT**: For identification purposes, fill in the last 4 digits of your Social Security number in the rightmost part of the "IDENTIFICATION NUMBER" section on the answer sheet.

3. Answer all questions. Make heavy black marks that fill in the numbered circle which represents your response.

4. Erase cleanly any responses you wish to change.

5. Make no stray markings of any kind on the response sheet.

6. Do not staple, fold, or tear the response sheet.

7. Do not make any markings on the questionnaire sheet.

You have been provided with one answer sheet. Do NOT fill in your name on the answer sheet so that your responses will be anonymous.

Each answer sheet item provides 10 response items. Some questionnaire items may require a response from 1-7 or 1-5 only. Therefore, be careful to fill in the appropriate response.

The following items ask you to indicate your confidence in whether you could use C2IPS under a variety of conditions. For each of the following conditions, indicate your confidence about your judgment by choosing a number from 1 to 9, where 1 indicates "Not at all confident", 5 indicates "Moderately confident," and 9 indicates "Totally confident".

For example, consider the following sample item:

I COULD COMPLETE THE JOB USING C2IPS...

If there was no one to tell me what to do as I go. Not at all Confident 1 2 3 4 5 6 7 8 9 Totally Confident

---

I could perform my assignment/duties using C2IPS...

1. if there was no one around to tell me what to do as I go.
2. if I had never used a system like C2IPS before.
3. if I had only the C2IPS user manuals for reference.
4. if I had seen someone using C2IPS before trying it myself.
5. if I could call someone for help if I got stuck.
6. if someone else had helped me get started.
7. if I had a lot of time to complete the job for which C2IPS was provided.
8. if I had just the built-in help facility for assistance.
9. if someone showed me how to do it first.
10. if I had used similar systems like C2IPS to do the same job.

The following items assess your views about C2IPS. The items are in the form of a short statement accompanied by the 7-point scale shown below. Fill in the circle on your answer sheet which most closely represents your view. For example, consider the following question:

My interaction with C2IPS is understandable. Strongly Disagree 1 2 3 4 5 6 7 Strongly Agree

The scale numbers correspond to the following views:

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

---

11. Using C2IPS improves my performance on the job.
12. Using C2IPS in my job increases my productivity.

(TURN PAGE→)

(1) Strongly Disagree
(2) Moderately Disagree
(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
(5) Somewhat Agree
(6) Moderately Agree
(7) Strongly Agree

13. Using C2IPS enhances my effectiveness in my job.

14. I find C2IPS to be useful in my job.

15. My interaction with C2IPS is understandable.

16. Interacting with C2IPS does not require a lot of mental effort.

17. I find C2IPS to be easy to use.

18. I find it easy to get C2IPS to do what I want it to do.

The next four questions each have a different scale:

19. Using C2IPS is a __________ idea. Bad 1 2 3 4 5 6 7 Good

20. Using C2IPS is a __________ idea. Foolish 1 2 3 4 5 6 7 Wise

21. I __________ the idea of using C2IPS. Dislike 1 2 3 4 5 6 7 Like

22. Using C2IPS is _________. Unpleasant 1 2 3 4 5 6 7 Pleasant

(TURN PAGE→)

Following is a generalized list of standard AMC C2IPS system administrator tasks. Use the 5-point scale shown below to rate yourself on your ability to perform these tasks.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

A rating of "3" indicates your performance is "in the middle" of those with similar experience/skill level.

Using C2IPS, how well do you…

23. …configure IPS Local Area Network components?

24. …enter operating system commands for basic operations?

25. …enter operating system commands to manipulate software elements?

26. …create an automated command procedure?

27. …perform disk management tasks?

28. …configure network operating system software in accordance with established guidelines?

29. …perform internet addressing?

30. …perform TCP/IP procedures?

31. …configure the Local Area Network?

32. …configure the Wide Area Network (WAN) subsystem for global operation?

33. …perform VMS system backup and environment modification?

34. …perform SMC system administration tasks?

35. …establish node communications parameters?

36. …supervise system operations?

37. …execute SQL statements to retrieve and display database information?

38. …manage IPS database integrity?

39. …perform C2IPS security implementation procedures?

40. …perform C2 IPS security maintenance procedures?

41. …configure IPS application software?

42. …operate IPS application software?

43. …perform fault isolation?

44. …perform restoration functions?

(TURN PAGE→)

The following question asks you to make an overall assessment of your C2IPS performance. Use the 5-point rating scale outlined below to rate yourself on your overall performance on C2IPS.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(6) Perform above average
(7) Perform well above average

45. Overall, how do you rate your C2IPS performance?

The following items focus on background information.

46. Are you a(n):

    (1) Enlisted
    (2) Officer
    (3) Wage Grade (WG) Civilian Employee
    (4) General Schedule (GS) Civilian Employee
    (5) Contractor
    (6) Other

47. What is your grade level (e.g. E3, O2, etc.)?

    (1) 1-2
    (2) 3-4
    (3) 5-6
    (4) 7-9
    (5) 10-13
    (6) 14-15
    (7) SES
    (8) N/A

48. If you are enlisted, what is your skill level? (If you are not enlisted answer N/A)

    (1) 3-level
    (2) 5-level
    (3) 7-level
    (4) N/A

49. What is your age?

    (1) Under 20 years
    (2) 20-30
    (3) 31-40
    (4) 41-50
    (5) 51-60
    (6) Older than 60 years

50. What type of organization do you work in?

    (1) Wing/Base
    (2) Numbered Air Force
    (3) MAJCOM staff
    (4) Other

(TURN PAGE→)

51. What is your gender?

(1) Male
(2) Female

52. On average, how much time during the day do you spend on C2IPS?

(1) None
(2) Less than 1 hour
(3) 1-3 hours
(4) 4-6 hours
(5) 7-8 hours
(6) More than 8 hours

53. How much previous experience do you have with C2IPS in your job?

(1) None
(2) 1-6 months
(3) 7-12 months
(4) More than 12 months

<u>END OF SURVEY</u>

- **ENSURE *ALL* QUESTIONS HAVE BEEN ANSWERED**
- **ENSURE THE LAST 4-DIGITS OF YOUR SSN ARE FILLED IN ON THE ANSWER SHEET**
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This questionnaire contains 54 items (individual "questions"). All items must be answered by filling in the appropriate spaces on the machine-scored response sheets provided. If for any item you do not find a response that fits your situation exactly, use the one that is closest to the one that meets your situation.

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For example, consider the following sample item:

I COULD COMPLETE THE JOB USING C2IPS…

If there was no one to tell me what to do as I go.	Not at all Confident	1	2	3	4	5	6	7	8	9	Totally Confident

---

I could perform my assignment/duties using C2IPS...

1. if there was no one around to tell me what to do as I go.
2. if I had never used a system like C2IPS before.
3. if I had only the C2IPS user manuals for reference.
4. if I had seen someone using C2IPS before trying it myself.
5. if I could call someone for help if I got stuck.
6. if someone else had helped me get started.
7. if I had a lot of time to complete the job for which C2IPS was provided.
8. if I had just the built-in help facility for assistance.
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The following items assess your views about C2IPS. The items are in the form of a short statement accompanied by the 7-point scale shown below. Fill in the circle on your answer sheet which most closely represents your view. For example, consider the following question:

My interaction with C2IPS is understandable.	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

The scale numbers correspond to the following views:

(1) Strongly Disagree
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(3) Somewhat Disagree
(4) Neutral (neither Disagree nor Agree)
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(6) Moderately Agree
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---

11. Using C2IPS improves my performance on the job.
12. Using C2IPS in my job increases my productivity.

(TURN PAGE→)

(1) Strongly Disagree
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The next four questions each have a different scale:

19. Using C2IPS is a __________ idea.	Bad	1	2	3	4	5	6	7	Good
20. Using C2IPS is a __________ idea.	Foolish	1	2	3	4	5	6	7	Wise
21. I __________ the idea of using C2IPS.	Dislike	1	2	3	4	5	6	7	Like
22. Using C2IPS is _________. Pleasant	Unpleasant	1	2	3	4	5	6	7	

(TURN PAGE→)

Following is a generalized list of standard AMC C2IPS operator tasks. Use the 5-point scale shown below to rate yourself on your ability to perform these tasks.

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

A rating of "3" indicates your performance is "in the middle" of those with similar experience/skill level.

Using C2IPS, how well do you...

23. ...demonstrate sign-on/sign-off procedures?

24. ...interpret the mission summary screen?

25. ...interpret the inbound mission screen?

26. ...interpret the outbound mission screen?

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36. ...interpret a mission schedule message?

37. ...revise a single mission?

38. ...interpret the aircraft control and status screen?

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41. ...receive and transmit the airlift schedule request message?

42. ...assign and update sequence of events (SOE)?

43. ...interpret the incomplete/recurring message screen?

44. ...interpret the outgoing message to approve screen?

(TURN PAGE→)

(1) Perform well below average
(2) Perform below average
(3) Perform average
(4) Perform above average
(5) Perform well above average

45. ...interpret the single mission display screen?

The following question asks you to make an overall assessment of your C2IPS performance. Use the 5-point rating scale outlined below to rate yourself on your overall performance on C2IPS.

(1) Perform well below average
(2) Perform below average
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46. Overall, how do you rate your C2IPS performance?

The following items focus on background information.

47. Are you a(n):

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    (4) General Schedule (GS) Civilian Employee
    (5) Contractor
    (6) Other

48. What is your grade level (e.g. E3, O2, etc.)?

    (1) 1-2
    (2) 3-4
    (3) 5-6
    (4) 7-9
    (5) 10-13
    (6) 14-15
    (7) SES
    (8) N/A

49. If you are enlisted, what is your skill level? If you are not enlisted answer N/A

    (1) 3-level
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    (3) 7-level
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50. What is your age?

    (1) Under 20 years
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(TURN PAGE→)

51. What type of organization do you work in?

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(2) Numbered Air Force
(3) MAJCOM staff
(4) Other

52. What is your gender?

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(2) Female

53. On average, how much time during the day do you spend on C2IPS?

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(5) 7-8 hours
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(4) More than 12 months

<u>END OF SURVEY</u>

- **ENSURE *ALL* QUESTIONS HAVE BEEN ANSWERED**

- **ENSURE THE LAST 4-DIGITS OF YOUR SSN ARE FILLED IN ON THE ANSWER SHEET**

TURN IN THE ANSWER SHEET TO YOUR INSTRUCTOR

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Vita

Captain Joseph H. Scherrer is from Herculaneum, Missouri. He graduated from Washington University in Saint Louis with a Bachelor of Science Degree in Electrical Engineering in 1989. Upon graduation, he was commissioned as a Distinguished Graduate of the Reserve Officer Training Corps as a Second Lieutenant (Regular). From there, he completed Basic Communications Officer Training and was assigned to the 1836th Engineering Installation Group, Lindsey AS, Wiesbaden, Germany. During his tour at Lindsey, Captain Scherrer engineered and installed fiber optic cable systems, weather systems, and secure communications systems throughout the European Theater. In 1992, he transferred to the 435th Communications Squadron, Rhein-Main AB, Germany. He served in several positions including Chief, Maintenance Control; Chief, Small Computer Support Center; Base Network Engineer; and Wing Staff. In addition, he deployed to the Bosnia Area of Operations (AOR) as Chief Communications Engineer and Chief, Systems Control for Operations Deny Flight and Provide Promise during which he provided communications for NATO's first-ever offensive strike.

In 1994, Captain Scherrer attended Squadron Officer's School at Maxwell AFB and from there was assigned to Headquarters Twelfth Air Force, Davis-Monthan AFB, Arizona as a Tactical Communications Engineer. He deployed several times to the Bosnia AOR and engineered communications that integrated the U-2 aircraft into NATO air operations. Captain Scherrer also has a Master of Science Degree in Business Administration from Boston University. Upon graduation, Captain Scherrer will be assigned to the Air Force Communications Agency (AFCA), Scott AFB, Illinois as a Network Systems Engineer.

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 074-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1998	Master's Thesis

4. TITLE AND SUBTITLE	5. FUNDING NUMBERS
AN ANALYSIS OF INFORMATION TECHNOLOGY TRAINING EFFECTIVENESS: THE IMPACT ON TRAINEE REACTIONS, LEARNING, AND PERFORMANCE	
6. AUTHOR(S) Joseph H. Scherrer, Capt, USAF	
7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S) Air Force Institute of Technology 2750 P Street WPAFB OH 45433-7765	**8. PERFORMING ORGANIZATION REPORT NUMBER** AFIT/GIS/LAS/98S-2
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Human Effectiveness Directorate 2698 G Street (Bldg 190) Wright-Patterson AFB OH 45433-7604	**10. SPONSORING / MONITORING AGENCY REPORT NUMBER**

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT	12b. DISTRIBUTION CODE
Approved for public release; distribution unlimited	

13. ABSTRACT (*Maximum 200 Words*)

Through its "Global Reach", the Air Force operates globally and in environments that are potentially dynamic, competitive, and lethal. "Information Dominance" has assumed a central role in such environments. In order to achieve Information Dominance, the Air Force must have trained and skilled personnel able to perform highly intensive activities using information technologies. Therefore, it is crucial that information technology training be able to deliver the requisite skills personnel need to attain and sustain performance on these systems.

This thesis analyzed the impact of information technology training on trainee reactions, learning, and performance via an information technology training program for a global Air Force command and control (C2) system. Trainee confidence, perceptions, attitudes, test scores, and performance with regard to the C2 system were analyzed to discover if the training positively increases any of these factors. The results indicated that training does increase these factors significantly even after the trainee returned to his/her job. Among the most important results was the dramatic increase in on-the-job performance improvement using the system after training.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Information Systems, Corporate Information Management, Management Information Systems, Performance (Human), Air Force Training, Transfer of Training, Training Management, Individualized Training, Command and Control Systems	197
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

AFIT Control Number AFIT/GIS/LAS/98S-2

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